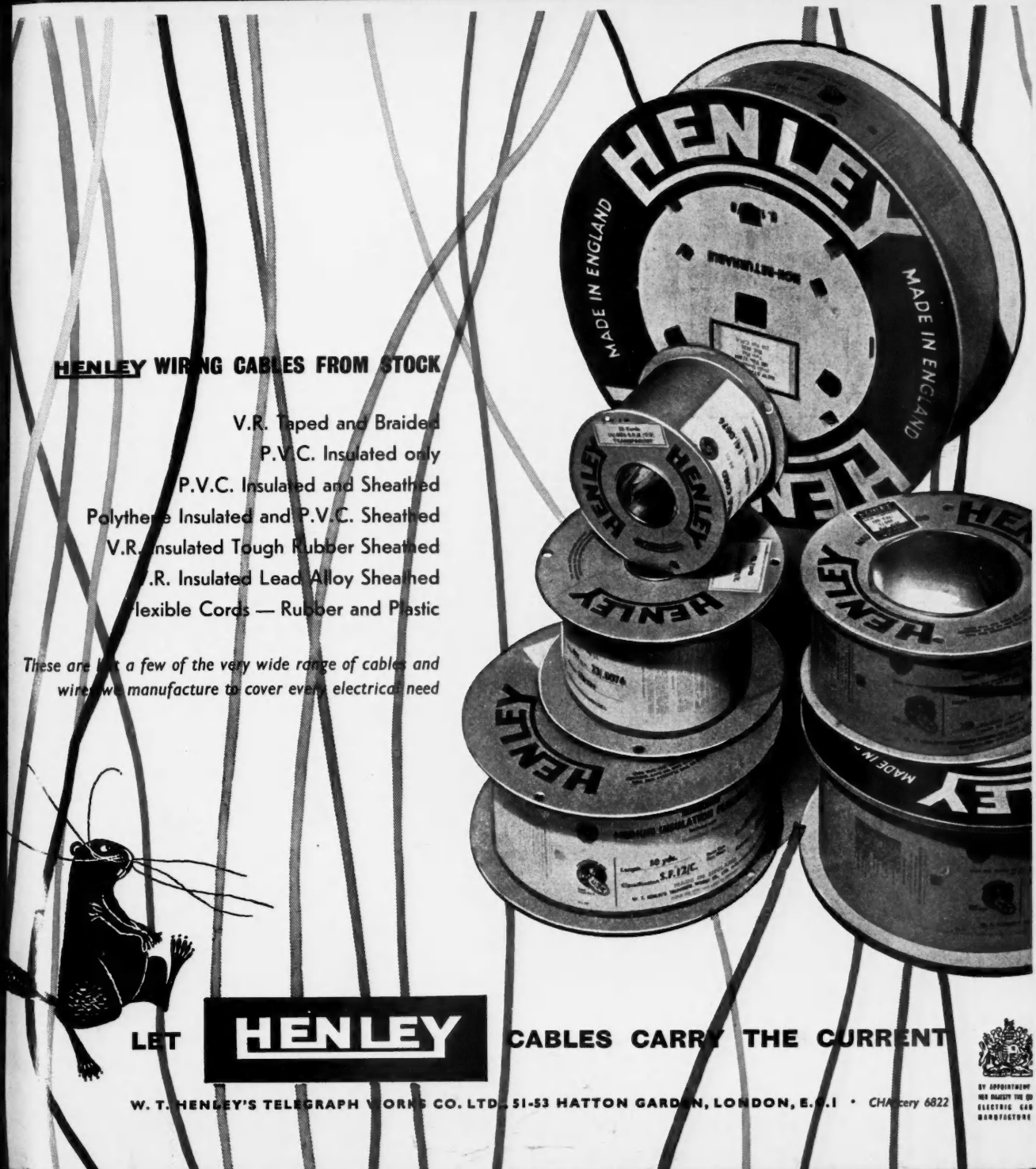
ELECTRICAL REVIEW



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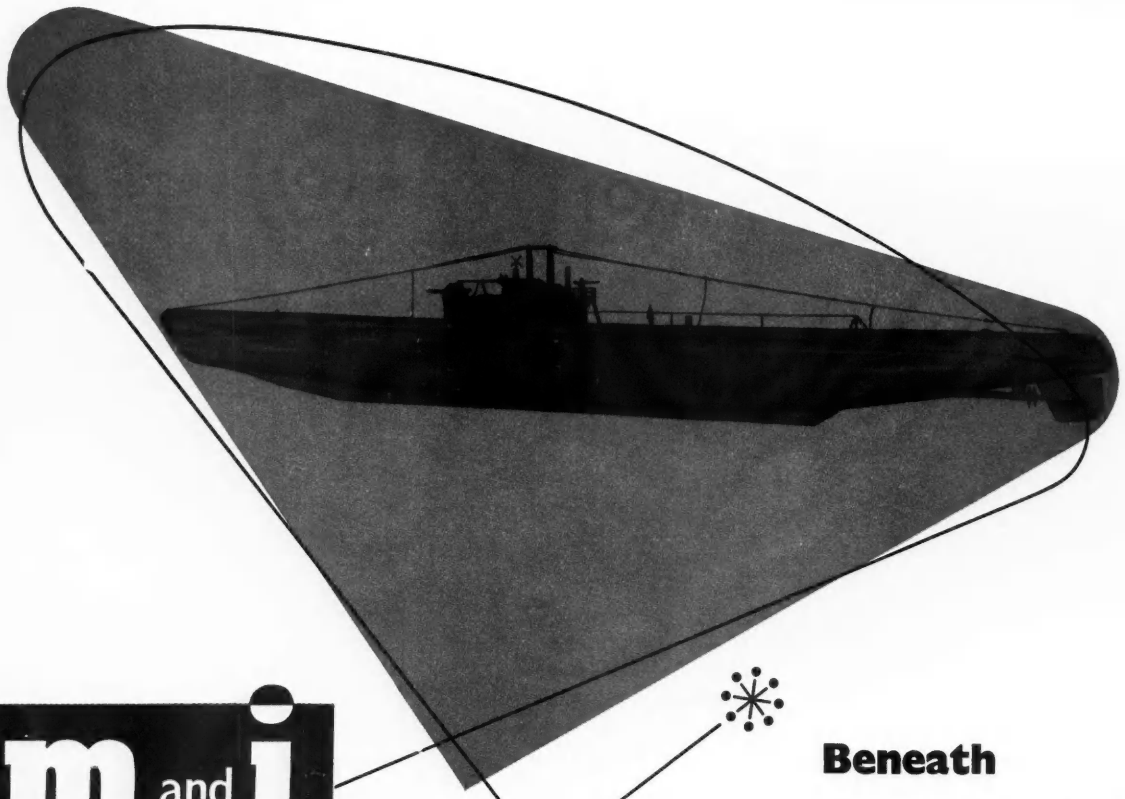

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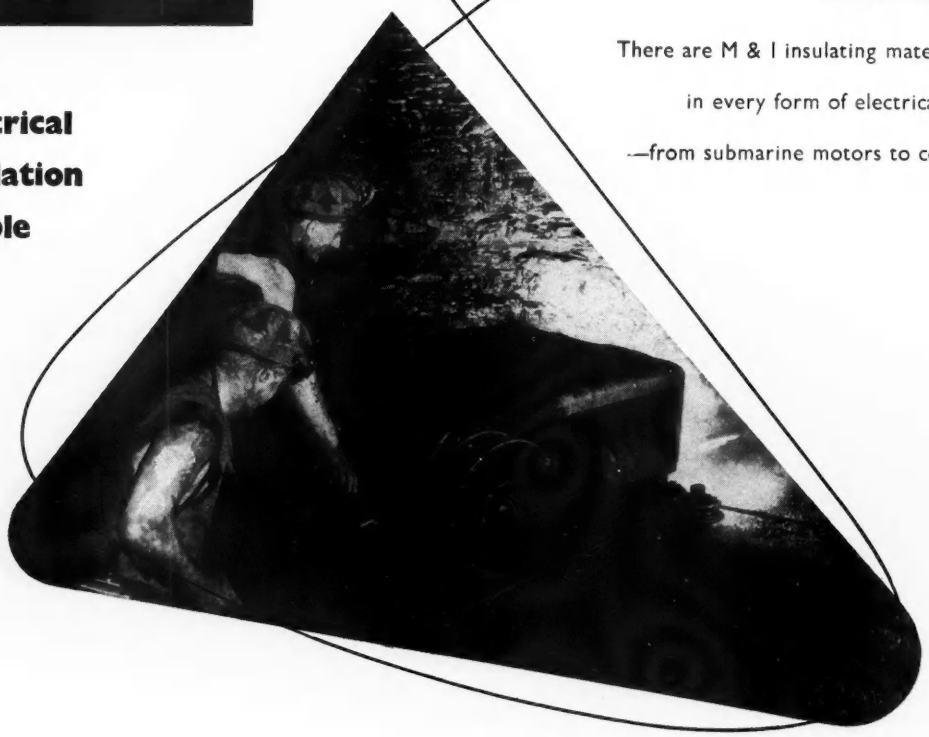

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29 MARCH
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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ELECTRICAL REVIEW

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The Balance of Power

BRIEF reference was made in last week's issue to addresses given by Sir John Cockcroft and Sir Josiah Eccles to the Parliamentary and Scientific Committee. Sir Josiah's remarks formed a succinct review of the power situation past and present and a forecast of future trends.

It was made clear that the Central Electricity Authority has put electricity supply on a sounder basis than existed when it took over in 1948. That is not to condemn its predecessors for they had not been given the chance to recover from conditions created by the war. Because of the limits imposed then a deficiency of 2 million kW had accumulated by 1947 and the demand continued to grow.

Never before had the electricity supply industry added more than three-quarters of a million kW of generating plant in any one year. By standardising on two sizes of generating sets and re-distributing the orders for boiler plant the C.E.A. was able by 1950 to envisage the possibility of an end to power cuts by 1955. It was then able to begin to take advantage of technical progress. This meant the installation of larger machines and boilers operating at higher pressures and temperatures, thereby reducing both capital costs per kW and operating costs. Sir Josiah showed that in this way the kW cost of power stations was about the same as in 1948, despite increases of 50 per cent in the prices of materials and labour. The improved efficiency had offset half of the coal price increases.

This led Sir Josiah to a survey of the coal situation and the need for supplementing what must eventually be a very inadequate supply of coal; it was estimated that the deficiency would be 17 million tons a year by 1965. As an immediate stopgap oil would be used to the extent, at full flow, of the equivalent of 8 million tons of coal a year. Ten-year oil contracts were signed two years ago. The first nuclear stations would go into service in 1961, and it was hoped that nuclear power would ensure that the country's electrical requirements would be more than met by 1965.

Fears have been expressed that we are over-insuring against future power demands, but Sir Josiah said that although the situation would require careful handling it was fairly flexible. If it proved that there was more than enough fuel we could export more coal (a very desirable thing); try to reduce the intake under the oil contracts; or ease back a little on the nuclear power programme.

He realised that those who were responsible for making this great nuclear power investment pay its way must see that they got value for money, that the plant would be reliable and that its useful life would be long enough to allow of a rate of depreciation that would not overburden the cost of electricity produced by these stations. He said that the programme posed problems in the procurement of materials and labour, as well as of design, matters on which we commented in our issue of 15th March.

BULK SUPPLY TARIFF

One of the many matters raised in the discussion on the Committee stage, now concluded, of the new Electricity Bill concerned the clause relating to tariff fixing by the Generating Board. Following earnest representations by Mr. A. M. F. Palmer and others, the Government announced their intention of deleting the paragraph requiring all differences in prices to correspond to differences in cost. This lends a special interest to the publication last week of the Central Electricity Authority's bulk supply tariff for 1957-58, reviewed on p. 575.

The chief innovation in this year's tariff is the introduction of a very elaborate fuel-cost variation in the running charge designed to bring it more into line with generation costs. In its original form the fuel-cost variation was a simple coefficient for relating the energy supplied to an area with the cost of coal burnt in that area. In recent years this has become increasingly unrealistic because it is attached also to supplies which are imported from areas having different fuel prices. The new formula adjusts for varying proportions of imported supplies at various fuel prices in what appears to be a highly ingenious if barely comprehensible manner. Fortunately this tariff is only for internal consumption and does not normally concern the layman: the latest attachment is certainly no contribution towards " the simplification of methods of charge."

THE WAGES DISPUTE

At the close of the first week's stoppage in the shipbuilding industry about a third of the workers in engineering establishments came out on strike to enforce a claim for a 10 per cent increase in wages. Discussions between the parties in the shipbuilding industry and the Minister of Labour broke down on Monday and the Minister announced his decision to set up a court of inquiry. Further moves in the engineering dispute appeared to wait upon developments in the shipbuilding section.

At this stage we do not wish to say anything which might prejudice negotiations, but we feel justified in pointing out that eventually some sort of compromise must be reached. Some of those concerned have been talking of " a fight to the finish." If this threat were carried out and there was a protracted stoppage the country would be put into an extremely grave position and both employers and employed would be among the sufferers.

E.H.V. POWER CABLES

In his article on e.h.v. power cables, which is published in this issue (page 551), Mr. C. T. W. Sutton makes it clear that although economic considerations very often dictate the use of overhead lines for the transmission of electricity at the very high voltages of, say, 275 kV and above, the underground cable is here to stay for these conditions because of the limitations upon the use of overhead lines for certain reasons, e.g., in built-up areas.

The author also makes it clear, however, that there are limitations in the case of underground cable, but these appear to apply more to their production than to their installation. For instance, he says: " It has not been possible to produce entirely new designs owing to the limitations of materials and processes. Instead, the four principal types (oil-filled, compression, gas-impregnated and gas-filled) have been adapted for the purpose."

Closely associated with these factors are other limitations in the matter of testing. Mr. Sutton points out that investigations relating to these cables must include a series of searching type tests to which the final designs must pass successfully. In Great Britain this work has been much simplified by the formulation of type test procedure which has been mutually agreed by the electricity supply authorities and the Cable Makers' Association. Above all the author emphasises that the principal factor upon which all h.v. cables depend is the electrical stress that the dielectric can withstand continuously whatever conditions are likely to be encountered in service.

BRITISH SCIENTIFIC INSTRUMENTS

Most engineers and scientists connected with research and development look forward to the annual exhibition of scientific instruments and allied apparatus which is organised by the Physical Society. The exhibits embrace almost every conceivable industry and the majority of the items on view are either prototypes or have been developed since the previous year's exhibition. This makes the exhibition catalogue a most useful document and it has come to be regarded amongst instrument engineers as an essential work of reference in this highly specialised field.

Earlier this week the forty-first exhibition in the series was held in London and as usual the capabilities of British scientific instrument designers were well demonstrated. In our next issue we shall be publishing a review of the trends in design indicated by the exhibits, together with brief descriptions of some of the items of more general interest.

SINGLE-PHASE LOCOMOTIVES

Although the authors of the I.E.E. papers on rectifier locomotives, some particulars of which were given in last week's issue, do not claim to have found an ideal solution to the many problems involved in determining the best combination of equipment, their comments on the characteristics of the numerous components and their appropriate combination are likely to be most helpful. Experience of the 50 c/s system is as yet insufficient for any final pronouncements, but one of its features is, perhaps paradoxically but surely of high merit, that it depends mainly upon the series-wound d.c. motor with its unexampled record of reliability.

ELECTRICAL ENGINEERS' EXHIBITION

More than 380 exhibitors are taking part in the sixth Electrical Engineers' Exhibition, the largest yet organised, which is being held at Earls Court, from Tuesday to Saturday, 9th to 13th April. Next week's issue of the *Electrical Review* will contain a stand-by-stand description of the exhibits many of which will be illustrated

E.H.V. Power Cables

Review of Recent Progress in Design

By C. T. W. SUTTON, M.Sc., M.I.E.E.*

THE rapid increase in the demand for electric power has posed many problems in the field of electrical transmission. Increasingly higher voltages are being used or contemplated as more and more load is put on to an overhead line or underground cable. Overhead lines must, in many instances, be employed on economic grounds, but underground cables are playing an increasingly vital role in the overall plan, being used wherever overhead lines are not practicable.

The present designs of cables which can fulfil satisfactorily these requirements are the result of very long and intensive development. This work can be divided roughly into three main parts, viz.:—

(1) Producing designs using an impregnated paper dielectric capable of withstanding all the conditions of voltage variation and current loading likely to be encountered at very high voltages, e.g. 275 kV, 400 kV.

(2) Providing new techniques to overcome installation problems and hazards.

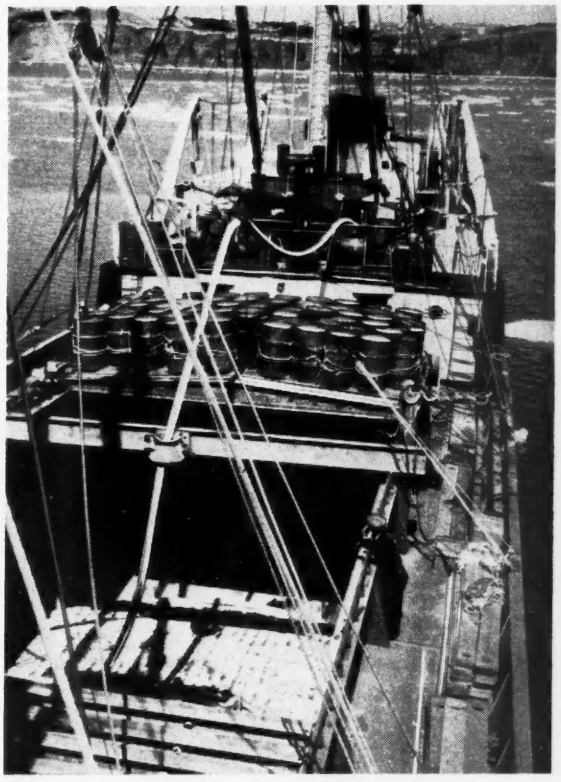
(3) Adapting new materials and processes to the design and manufacture of h.v. cables.

From a cursory examination of the first of these problems, it was obvious that even with "controlled" pressure cable designs it was not economic or even possible to apply the same bases as were used successfully for lower voltages (e.g. 66 kV). Unfortunately, a plastics dielectric has not been developed to replace impregnated paper and it appears unlikely to appear for some time. Consequently, more effective use has had to be made of paper insulation which is applied to the conductor in tape form and afterwards, with one exception, vacuum dried and then impregnated with a low-loss oil or compound. It is the behaviour of this composite dielectric in service which causes the greatest concern to designers of e.h.v. cables.

It has not been possible to produce entirely new designs owing to the limitations of materials and processes. Instead, the four principal types (oil-filled, compression, gas-impregnated and gas-filled) have been adapted for the purpose. Investigations of this nature must include a series of searching type tests which the final designs must pass successfully. In Great Britain this work has been much simplified by the formulation of type test procedure which has been mutually agreed by the electricity supply authorities and the Cable Makers' Association.

Attempts have been made to ensure that these tests are as realistic as possible and a procedure has been drawn up which avoids repetitive testing; this has enabled very good progress to be made. Following these ideas the suggestion was made at the last C.I.G.R.E. Conference in Paris that a standard type test schedule should be agreed internationally to facilitate a fair assessment of the claims that a modified cable design had passed successfully the development stage.

* Enfield Cables, Ltd.



Laying of the Bell Island cable by Enfield Cables, Ltd.

The principal factor upon which all h.v. cables depend is the electrical stress that the dielectric can withstand continuously whatever the conditions likely to be encountered in service. With a.c. the electrical stress is a logarithmic function of the cable dimensions, so that the maximum stress (S max.) occurs at the surface of the conductor. There is no method of determining suitable values for S max. except by long and expensive experimental programmes. Such investigations have been conducted in the cable industry for many years, so that at the present time the range in the values of S max. that may apply has been well established. However, owing to the peculiar behaviour of an impregnated dielectric under load conditions, it has always been necessary to use a low value of S max. compared with the actual strength of the impregnated paper, and the investigations have enabled the gap to be narrowed between the actual and possible.

The weakness in the dielectric results from the spaces between the edges and layers of the paper tapes. These spaces should at all times be filled with oil or compound, but this condition is not always fulfilled and voids are formed which lead to failure of the dielectric. Many papers have explained this "failure mechanism."[1] To overcome this weakness and so bridge the maximum stress gap, efforts have been made to increase the paper content and reduce the oil or compound content.

At the same time, the effect of bending the cables, which can accentuate this weakness by producing creasing, has

been studied to determine bending radii that can be used during manufacture and installation. Papers with uniform composition and low electrical losses were applied to the conductor with precision in a controlled atmosphere. It has been a common practice to apply a simple grading technique by using thinner and denser papers adjacent to the conductor. This method has been extended successfully by Domenach[2] using linen fibre papers only 0·025 mm thick immediately over the conductors. Cables made in this way have greatly improved electrical characteristics, but there are disadvantages such as reduction in paper taping speed and increased hazards in bending.

Screening the conductor has also been found to improve the electric strength, but whereas in the past a metal foil was used, this has now been largely replaced by "carbon black" paper, two or more layers being applied immediately over the conductor during the paper taping operation. An improvement in both power frequency and impulse strength of up to 25 per cent has been demonstrated. As an additional refinement the carbon paper has, in some instances, been applied to the outside of the dielectric underneath the metal earth screen. It

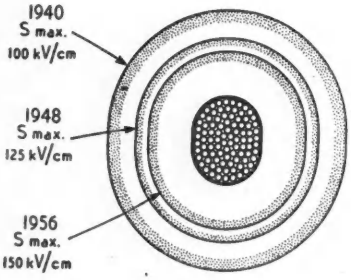


Fig. 1.—Comparison of insulation thickness at various stresses in 275 kV compression cable

is claimed that the carbon paper in this case acts as a protection against any action between the metal and the impregnating oil or compound. In Great Britain it has been possible by using the agreed type tests to determine quickly the effect of these modifications to the cable design.

Type Test Schedule

The three most important tests included in the type test schedule are the load cycle test, the thermal stability test and the impulse test. In the first case a 30 yd length of cable fitted with joints and end terminations is subjected to uniform heat cycle tests. The conductor temperature is raised above the safe continuous operating temperature and, at the same time, an over-voltage of 1·33 to 1·5 times working voltage is maintained continuously during the heat and cooling periods. The power factor is measured at regular intervals to determine whether progressive deterioration of the dielectric is taking place. In the thermal stability test the heating, together with the over-voltage, are maintained continuously on the sample for several hours with the external thermal resistance adjusted artificially to the correct value. Successful compliance with this test requires the conductor temperature to remain constant, so demonstrating that thermal instability will not occur.

The impulse test consists of subjecting the cable sample to a number of electric discharges of a definite waveform at eight to ten times the nominal working voltage. In most cases, ten positive, followed by ten negative impulses, are applied which the sample must withstand successfully. Recently some samples have then been taken to breakdown as this is considered necessary by some engineers because a wide spread of results has occurred in some instances. This may be eliminated if much greater lengths are tested when larger generators become available.

It has also been urged that the impulse test should be made at the maximum operating temperature instead of at room temperature. The demand for this is based on the influence of the viscosity of the oil or impregnating compound on the impulse strength of the dielectric. For example, in an oil-filled cable where the viscosity of the oil is low, little change occurs in the impulse strength over the temperature range in question. On the other hand, the loaded oil compounds, which have a high viscosity at low temperatures and a large reduction in viscosity with increase in temperature, can cause a drop in the impulse level at the working temperature. With present insulation level requirements, the impulse strength, rather than the power frequency strength, determines the dielectric thickness of a cable for transmission voltages above 100 kV.

Examination of Cable Materials

Turning to the question of cable materials, the behaviour of impregnating oils and compounds alone, or together with paper, has been studied extensively for many years. With modern compound such as polyisobutene, additional improvement is unlikely except by improving the methods of preparing the compound.

In the examination of factory processes and the effect of bending, etc., attention has recently been focused on the physical characteristics of paper. Further work in this direction could produce big improvements in the composite paper dielectric.[3,4]

As the lead sheath has to withstand the internal gas or oil pressure, together with cyclic movement in service, examinations have been necessary to determine the best alloys of lead for this purpose and much has been done by the addition of small amounts of metals such as arsenic copper and tellurium.

Mechanical failure of the lead sheaths due to corrosion of the metal reinforcing tapes now that a high internal pressure is used has necessitated a review of the methods used for corrosion protection. The most common practice, since the introduction some years ago of the rubber sandwich principle, is to apply a coating consisting of a combination of rubber or plastic tapes, fabric tapes and adequate layers of bitumen compound. The efficiency of such a coating has been determined by the saline bath test where the cable sample, after bending, is immersed in a 0·5 per cent salt solution and subjected to heat cycles. The results obtained have demonstrated that these coverings are effective for temperatures of 70 deg C and upwards. Unfortunately, in some instances, these coatings have failed to give complete protection in service. This has been due to ineffective sealing of the non-fibrous tapes, the unpredictable behaviour of certain rubber mixes in the ground, and mechanical damage due, for example, to the penetration of the coating of small flints during laying and back filling. Much thought has been given to establishing a testing procedure which will check the soundness of the coating during manufacture and installation, and at regular intervals afterwards, but the problem is complicated by the necessity of having a conducting external layer, and the reduction of the insulation resistance which has been found to take place with time. Modern thought suggests that more robust coverings are necessary to meet two requirements, i.e. high electrical and mechanical strength such as is possessed by the sheath of a flexible trailing cable. Coating of this nature can be applied and tested in a similar manner to ordinary rubber or plastic cables.

Sheaths of plastic, e.g. polyvinyl chloride, would appear

to be most promising, but the sheath should be extruded in preference to using a number of tapes which are afterwards vulcanised or sealed. Direct extrusion has only recently become practicable with the development of large plastic extruders capable of producing a sheathing of up to 5in or more in diameter.

The reader will by now appreciate that the main objective of the cable engineer has been to draw away from the art of cable making and instead to produce a cable with engineering precision. Consequently, new machines of larger size and incorporating new mechanism have had to be used. Paper lapping machines are now common which are capable of applying the thickest dielectric in one operation, where the tension, registration and condition of each tape is controlled and where a broken tape automatically stops the machine and is quickly detected. The continuous lead press is rapidly supplanting the ram press and more and more emphasis is being placed on the vacuum and temperature conditions used during drying and impregnating.

By these means cables are available using an S max. of 150 kV/cm or more compared with 90 to 100 kV/cm limit of a few years ago. It is now possible to use cables for 275 kV and 380 kV with a thickness of insulation little more than that required for half of these voltages a few years ago. Fig. 1 shows the shrinking dimensions of a 275 kV compression cable when higher maximum stresses are used, and Table I lists some recent cable installations.

Temperature Considerations

The main function of the conductor is to carry as much current as possible and because of the high prices of materials and labour this has become a very pressing problem. The loading of a cable, once the maximum operating temperature has been established, is principally controlled by the thermal resistances of the layers of materials wrapped around the conductor, and of these the largest is that of the ground. It has been customary in Great Britain in computing the rating of a cable to use a value for the ground thermal resistivity "g" of 120 and to assume an average soil temperature of 15 deg C.[5] At the same time, cables have been rated "continuously," i.e. the current required to cause the temperature of the conductor to be maintained continuously at the maximum permissible operating temperature. This procedure has worked very well but recently the method has been criticised from an economic point of view. Therefore, the factors influencing current rating are being reviewed, i.e. cyclic loading, emergency rating, the variation of the ground temperature and thermal resistivity "g," and the maximum permissible operating temperatures.

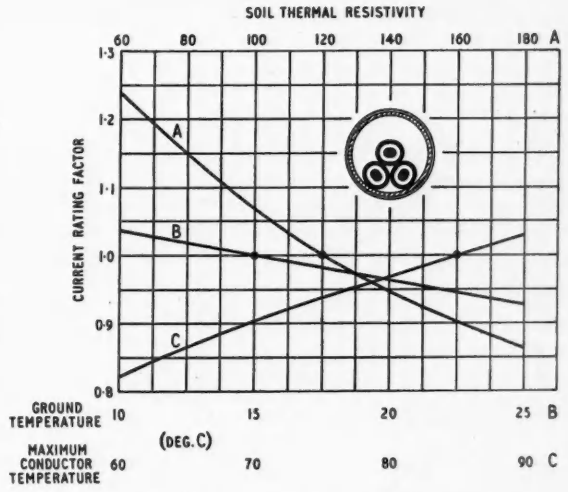


Fig. 2.—The effects of various factors on the loading of a 0·4 sq in three-core 132 kV pipe-line compression cable

Fig. 2 shows the effect of some of these factors on the loading of a 0·4 sq in three-core 132 kV pipe-line compression cable and it can be seen that the effect of "g" is the more important. It is not easy to determine "g" accurately and quickly as its value depends upon the composition of the soil which can vary from point to point along the route, and also with the weather. In more important installations it could be an advantage to control the value of "g" to a low value by back-filling the trench with treated soil, and to avoid cable congestion.

The demand for more power has led to the harnessing of energy resources in remote places, and this has required long e.h.v. transmission lines. As a rule, overhead lines are employed but for water crossings submarine cables must be used operating at the same voltage as the overhead lines. Laying a heavy e.h.v. submarine cable with a delicate dielectric, especially in deep water, is no mean task. The work is both hazardous and nerve-racking, but great progress has been made in recent years. Table II gives details of some of the more important submarine cables recently completed, and it will be seen that the progress has not been confined to one country or one design of cable.

For a submarine cable it is not sufficient to use a land cable with the addition of heavy armour. The first consideration is the mechanical strength not only of the cable as a whole but also how the stress during laying, etc.,

TABLE I

No.	Location	Type of Cable	Voltage	Route length	Description of Single-Core Cable					Country of Origin	Reference
					Conductor		Sheath	Dielectric			
			kV	yds	sq in	Material		Thick	S max. kV/cm		
1	Staythorpe Testing Station	L.P. Oil-filled	275–300	100	0·46	Tin Bronze	Lead	0·97	110	G.B.	—
2	ditto	Impreg. Pressure	"	100	*0·70	Alum.	Lead	0·98	110	G.B.	—
3	ditto	Compression	"	100	*0·40	Copper	Lead	0·80	150	G.B.	—
4	ditto	L.P. Oil-filled	"	100	0·30	Brass	Lead	0·81	130	G.B.	—
5	Harspranget, Sweden	H.P. Oil-filled	400	133	0·78	Copper	Lead	1·10	136	Sweden	C.I.G.R.E. 1952 Paper No. 205
6	Kemano-Kittimat, Brit. Columbia	L.P. Oil-filled	301	670	0·40	Copper	Lead	0·95	120	G.B.	A.I.E.E. Transactions Vol. 73, 1954, Part IIIB, p. 1166
7	ditto	L.P. Oil-filled	301	670	0·875	Alum.	Alum.	0·99	113	Canada	C.I.G.R.E. 1956 Paper No. 209
8	Lasele, Sweden	H.P. Oil-filled	425	98ft	1·7	Copper	Lead	0·866	161	France	—
					DIRECT CURRENT						
9	Kashira, Moscow	Mass-Impregnated	200	2 lengths 64 miles	0·235	Alum.	Lead	0·435	—	U.S.S.R.	C.I.G.R.E. 1956 Report

* Current carried by part of conductor only.

will be shared by the conductor and armour. The dielectric should be tough with good electrical properties which will not be affected seriously by severe bending and twisting. The lead sheath must be free from pinholes and other flaws. The method of corrosion protection, especially when reinforcing tapes are used, must be infallible. Joints, if used, must not constitute a weak link in the cable run.

For ease of laying, a submarine cable should be finally in one length because once the laying commences, especially when paying off from a ship, the operation should be continuous. Two methods have been used to achieve this object; to manufacture the cable in one continuous length, which is possible n the case of the gas-filled design, or to use flexible joints.

Flexible joints are designed so that their overall diameter is little more than that of the cable and they possess comparable flexibility. Normal practice is to manufacture the cable in as great a length as possible, make the flexible joints behind the armouring machine, apply the corrosion protection by hand and then armour the whole length. For the St. Lawrence Crossing, No. 3, Table II, an armouring plant was assembled on site.

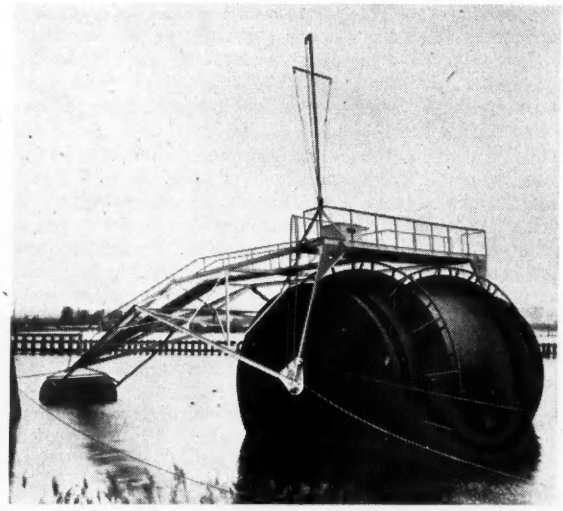
The use of rigid joints cannot be ignored, because faults are frequently caused by ships' anchors. For the first 132 kV flat oil-filled pressure cable, No. 4, Table II, lengths of 1,000 metres were laid in the sea and were afterwards joined together by rigid joints.

For very long crossings no single method could be used because the continuous manufacture of very long lengths would be uneconomic, especially when taking into account the size and cost of the ship that would be necessary. A compromise of long lengths, possibly including flexible joints joined by rigid joints at strategic points, would seem the logical answer.

Laying Submarine Cables

Three methods for the installation of submarine cables are in common use:—(i) from a drum on the deck of a vessel, (ii) from a coil in the hold of a ship, the ship being designed for cable laying, or temporarily set up for the work, and (iii) by means of a floating drum, after the manner of " Pluto."

The first method is limited to short, calm crossings, although it has been extended by using several vessels in series. The second method is more common, having been used from the very commencement of laying submarine telegraph cables. The chief drawback of this method is the high cost of chartering a ship, especially if a long waiting period is necessary. For example, in the case of No. 1 in Table II the ship approached to within 50 miles



Floating drum of Northern Cable and Wire Works, Copenhagen

of its destination and, due to freak atmospheric conditions, was then ice-bound for over two months before conditions became favourable. The coiling and uncoiling into and out of the hold of a ship and dropping into the water can severely bend and twist the cable, with adverse effects on the dielectric.

In the case of the floating drum these difficulties are avoided. For example, in the second 132 kV flat cable, No. 5 in Table II, flexible joints were made on the dockside after which the cable was coiled on to the drum. Improvement could be effected by reducing the time necessary to tow the drum to site and back. The best solution would be to fit a drum or drums into a specially constructed ship like a tank-landing craft, where permanently installed equipment is provided for controlling the cable during loading and laying.

Turning to new materials for cables, the most significant changes are taking place in the conductor and sheath. It has already been mentioned that the immediate replacement of the impregnated paper is unlikely. Extruded polythene is the most promising material but so far its use has been limited to 30 kV. The most important change has been the introduction of aluminium, first to replace the lead sheath when doubts arose regarding future supplies of lead and, subsequently, for the conductor for economic reasons.

For a time doubt was expressed as to the possibility of

TABLE II

No.	Location	Type of Cable	Voltage kV	Length miles	Description of Cable			Type of Joint	Max. depth of laying, ft	Country of Origin	Reference
					Conductor sq in	No. of Cores	Finish				
1	Bell Island, Newfoundland	Mass-Impregnated S.L. Type	33	3·6	0·17	3	Each core Rubber Sandwich S.W.A.	Flexible	500	G.B.	—
2	Lake Maracaibo, Venezuela	Mass-Impregnated S.L. Type	33	2 lengths of 16½	0·10	3	Each core P.V.C. Sheathed S.W.A.	Rigid	120	G.B.	Siemens Eng. Bulletin No. 274
3	St. Lawrence, Canada	Compression	69	4 lengths of 30	0·39	1	Rubber Sandwich Alum. Alloy W.A.	Flexible	1,200	Canada	" Possibilities of a Cross Channel Link." I.E.E. Vol. 101 Part 1, Sept. 1952
4	Oresund, Denmark	Flat Oil-Filled Pressure	132	3½	0·30	3	Rubber Sandwich Copper Armour	Rigid	145	Denmark	"Flat Pressure Cable." I.E.E. Vol. 103 No. 8, April, 1956
5	ditto	ditto	132	3½	0·40	3	Rubber Sandwich Alum. Alloy W.A.	Flexible	100	Denmark	
6	Aero, Denmark	ditto	70	7	0·078	3	ditto	Flexible		Denmark	—
7	Vancouver Island	Gas-Filled	138	5 lengths of 16 4 x 3	0·35	1	Vulcanised Rubber Sheath S.W.A.	—	600	G.B.	BEAMA Journal Vol. 63, No. 4 Nov. 1956, p. 154
					DIRECT CURRENT						
8	Isle Gotland, Sweden	Mass-Impregnated	100	60	0·14	1	Double Lead Sheath S.W.A.	Flexible	450	Sweden	A.I.E.E. Transactions Vol. 73, 1954 Part IIIA, p. 599

extruding aluminium direct on to the dielectric. However, it was soon demonstrated that by using a double ram press the dielectric would not be harmed at the high temperatures, provided the time of exposure was short. It is now possible to extrude an aluminium sheath on to a paper-insulated cable but for various reasons the process is not yet a commercial proposition. In the meantime, a process was developed where the paper-insulated cable, after impregnation, is pulled into an oversized aluminium tube, which is then swaged down on to the cable. This has enabled the highest voltage cables to be sheathed with aluminium and many hundreds of miles have been produced and installed.

The initial impetus of using an aluminium sheath has not been maintained due to a number of setbacks, e.g. corrosion of the sheath in the ground, difficulties of installation and jointing, and the now adequate supply of lead. To overcome the first two difficulties the sheath has been corrugated to facilitate bending and it is now mandatory to apply a corrosion protection which includes an impermeable layer, e.g. in the form of a rubber sheath or " sandwich."

Recently, thought has been given to the use of aluminium for the conductor owing to the very high and fluctuating price of copper. Where the conductor is of reasonable size, a saving of up to 20 per cent is possible. Although copper has many advantages in jointing, installation, etc., which will probably reduce the price advantage for aluminium, the economic advantages are still attractive. From a manufacturing point of view no major changes are necessary when aluminium is used for the conductor.

Advantages of Steel Pipe

Another interesting development has been the use of a steel pipe instead of a reinforced lead sheath. Mild steel pipes of about 6in diameter and in random lengths up to 40ft are laid in the trench, after which they are welded into continuous lengths between joint positions. After a hydraulic test a three-core cable is pulled in and the straight joints are made. Steel joint sleeves are welded to the pipe which is then filled with gas or oil at 200 lb/sq in.

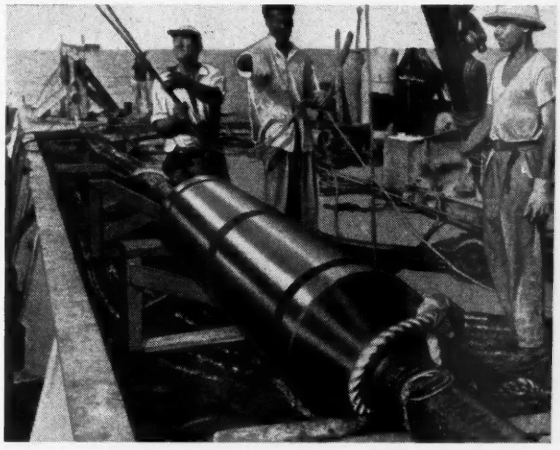
The steel pipe was first used in 1932 in Great Britain for a 66 kV compression cable installation.[7] Subsequently, many pipe-line installations were completed in Germany during the pre-war period and in recent years steel pipe installations have come rapidly into favour in the United States and in France.

The steel pipe has many advantages: high mechanical strength, simplicity of installation, ease of cable replacement, high current rating and unlimited voltage application. The steel pipe permits very long cable lengths in congested areas, as only restricted excavation is required at one time, as compared with the whole length between joints in the ordinary way. Some corrosion trouble was experienced with early installations but this has now been largely overcome by the development of improved coating of butyl rubber and applying some form of cathodic control. Experience has shown that when a leak has occurred it is usually the result of electrolytic corrosion, in which case the affected area is small. This enables the gas pressure to be maintained so that the cable can remain in service while the leak is being located.

With the application of h.v. cables for submarine crossings, new interest has been shown in the use of d.c. transmission. This has resulted in some controversy as to the relative merits of a.c. and d.c. transmission, but this controversy has not been so great as that which took place at the turn of the century when a.c. was supplanting d.c. Then many fears were allayed effectively by a practical demonstration, for Ferranti proved by the installation of the now famous 11 kV cable that a.c. was practical. The modern parallel can be found in the work of the Swedish engineers with their successful d.c. installation from the Swedish mainland to the Island of Gotland.[8] This, together with the pioneer work carried out in Germany, and the recent progress made in the U.S.S.R. has demonstrated beyond doubt the practicability of h.v. d.c. transmission. It is encouraging and interesting to note that the Central Electricity Authority and Electricité de France have recently announced that the link across the Channel between their two systems will be by d.c.

Comparison of D.C. and A.C.

Preliminary considerations would indicate that for a given transmission capacity the d.c. cable will be cheaper than the equivalent cable for a.c. This is prompted by the absence of the effects of capacitance, charging current, inductance, etc., and also to the increase of dielectric strength with d.c. These characteristics should permit a higher S max. and increased current rating with the same maximum operating temperature to be used. However, unless care is taken to prevent voltage variations being imposed upon the system, the impulse requirement could easily be the predominating factor in the cable design. Tests have also shown that the dielectric strength is seriously decreased if voids are present due to compound migration.



Rigid joint for the Maracaibo installation by Siemens Bros.

The development of cable for d.c. necessitates a different approach to the problem of the maximum electric stress in the dielectric. In the a.c. case the electric stress is a function of the permittivity of the dielectric and its geometry. Since the permittivity is not a function of temperature the point of maximum electric stress in the dielectric remains unchanged. In the d.c. case the electric stress is a function of the resistivity of the dielectric and its geometry. The resistivity is a function of temperature and, therefore, varies with conductor current loading and time. It is possible for the cable at maximum operating temperature to have a higher stress at the sheath than at the conductor.

In view of the complexity of the problem of stress determination it is desirable that the dielectric should be as homogeneous as possible, and in this case a controlled design which does not allow void formation or compound

migration is preferable to a solid-type cable. The impregnating compound should also show as little variation of resistivity with temperature as possible.

It may be possible to avoid these difficulties by using a polythene or rubber insulation as these materials are relatively unaffected by moisture, dielectric changes, and mechanical damage.[9] Their use has so far been prevented by the inability of applying to the conductor a " void free " dielectric of the required thickness. Failures on test have shown that breakdown always commences in these voids. Improved plant and manufacturing methods may enable a homogeneous dielectric to be produced.

REFERENCES

[1] O. M. Robinson, " Dielectric Phenomena in High Voltage Cables," Chapman & Hall, 1936.
[2] L. Domenach, " Cables for 220 to 400 kV," C.I.G.R.E., 1954, Report No. 217.
[3] H. C. Hall and E. Kelk, " Physical Properties and Impulse Strength of Paper."
[4] H. C. Hall and D. J. Skipper, " The Impulse Strength of Lapped Impregnated Paper Dielectric," *I.E.E. Proceedings*, Part A, December, 1956, p. 564.
[5] E.R.A. Report F/T 183.
[6] G. Bertaux, " A Process of Liaison between High Voltage Cables by means of Equidiametral Flexible Junctions," C.I.G.R.E. 1954, Report No. 220.
[7] E. Bowden and F. W. Main, *Electrical Power Engineer*, Vol. 15, November, 1933, p. 639, etc.
[8] B. O. N. Hansson, " A Submarine Cable for 100 kV D.C. Power Transmission," *A.I.E.E. Transactions*, Vol. 73, 1952, Part IIIA, p. 599.
[9] R. C. Mildner, " Polythene Insulated High Voltage D.C. Cables," *Direct Current*, Vol. 1, No. 8, March, 1954.

New Books

Boiler House Practice. By J. N. Williams, M.I.C.E., M.I.Mech.E., F.Inst.F. 2nd Edition. George Allen & Unwin, Ltd., Ruskin House, 40, Museum Street, London, W.C.1. Price 60s.

The present edition is a recent revision of the author's publication on this subject printed in 1953. The original edition had long been recognised as a standard book of reference covering the wide field of " Boiler House Engineering," but developments in the field of plant engineering have been at such a rapid pace during recent years that the author has very wisely rewritten much of the descriptive part of the book, and given added emphasis to the theoretical background on this subject. This well-produced, well-printed edition deals with the major aspects of boiler and auxiliary plant operation in a thoroughly readable, interesting and informative manner, and will thus be a source of useful information to all classes of engineers interested in this subject.

To those in their apprenticeship or student days the most useful function of this edition will be to provide excellent illustrations and descriptions of modern boiler and auxiliary plant. The technical mathematics throughout the edition have been kept to the barest essentials and should be well within the capacity of the advanced student.

The engineer who is making power plant a career will be interested in the mass of detailed operation information contained in the text and will be able to make comparisons of the operation of his own plant with that of other designs. The manifold plant descriptions and performance data will be of great value to those engaged on the designing of power stations.

The acknowledgments at the end of each chapter can be used to obtain further and more detailed information on the specialist matter dealt with and are taken from current British technical publications. It must be said, however, that the chapter on steam costing scarcely treats this aspect of the subject with the importance placed on it in a highly competitive industry.—C.U.

Linear Transient Analysis. Vol. 2. Ernst Weber. Pp. 452; figs. John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 84s.

The second volume of " Linear Transient Analysis " is devoted to transient phenomena in passive and active four-pole networks, in filters, and in transmission lines. It is written in the same clear style as Volume 1, and is similarly based upon many years of teaching experience.

The Fourier and Laplace transform methods are used throughout the text, and Chapter 1 gives a brief review of these methods, thereby repeating some of Volume 1, but tending to make the volume self-contained.

The next four chapters cover the transient performance of four-pole networks composed of linear lumped parameters. Matrix notation is used to facilitate the analysis of networks in cascade, such as filters, and other lattice networks. A whole chapter is devoted to the application of the Fourier transform to these networks. This section is concluded by an analysis of active four-pole networks which may be considered as linear devices, such as electron tubes and transistors operating in the small signal region. A brief review of mechanical and thermal analogues is also included.

The last three chapters, about one-third of the book, present the transient analysis of four-pole networks composed of distributed linear parameters, that is to say, transmission lines. The general transmission-line equations are formulated, solved, and applied to distortionless and lossless lines by use of the travelling wave concept. A detailed description of the performance of non-inductive cables and the infinitely long general transmission line forms the concluding chapters.

Five useful appendices give mathematical background, and a bibliography, but it is assumed that the reader has a good working knowledge of the functions of a complex variable, and the transient analysis of lumped circuits as presented in the first volume.—K.W.W.

BOOKS RECEIVED

The History of Electric Wiring. By John Mellanby, M.A.(Cantab.), A.M.I.E.E., M.Inst.F., M.I.H.V.E. Pp. 244; figs. MacDonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 32s 6d.

Electricity and Magnetism. 1st Edition. By J. Newton, B.Sc., A.Inst.P. Pp. 613; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 25s.

Television Engineering Principles and Practice. Vol. 3. By S. W. Amos, B.Sc.(Hons.), A.M.I.E.E. and D. C. Birkinshaw, M.B.E., M.A., M.I.E.E. Pp. 226; figs. Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 30s.

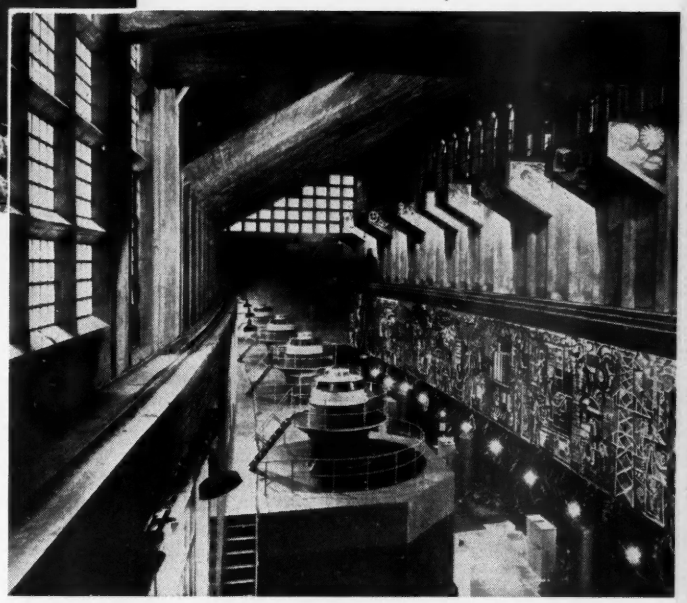
Foundations of Wireless. 6th Edition. By M. G. Scroggie, B.Sc., M.I.E.E. Pp. 349; figs. Published for *Wireless World* by Iliffe & Sons, Ltd. Price 12s 6d.

Paint Trade Manual of Raw Materials and Plant. 2nd Edition. Compiled by H. W. Chatfield, Ph.D.(Lond.), B.Sc.(Hons.), F.R.I.C., M.I.Chem.E. Pp. 282; tables. Scott Greenwood & Son, Ltd., 83-86, Farringdon Street, London, E.C.4. Price 24s.

Boiler Plant Instrumentation. By W. R. L. Kent and D. C. Gunn in collaboration with G. F. J. Murray. Pp. 159; figs. Heywood & Co., Ltd., Ingersoll House, 9, Kingsway, London, W.C.2. Price 21s.

Data Book on Electric Motors. By E. Molloy. Pp. 168; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 12s 6d.

SALIME HYDRO-ELECTRIC POWER STATION



Above: The reservoir and dam for the Salime hydro-electric power station in Northern Spain. Right: Interior view of Salime power station showing the four 35 MVA English Electric generating sets

SPANISH WATER POWER

As part of extensive Spanish hydro-electric developments the River Navia in Asturias is being fully exploited. This work is being undertaken jointly by Electra de Viesgo S.A. and Hidroelectrica del Cantabrico S.A. These two companies have formed a subsidiary named Saltos del Navia de Comunidad to carry out the construction work.

The River Navia rises in the mountains between Lugo and Ponferrada and flows northwards to enter the Bay of Biscay at the fishing village of Navia, about 90 km west of the port of Gijon. The river is only 115 km long, but in this distance it falls 400 m. When the river is fully exploited, five hydro-electric power stations will have been built, and these will help to supply the mining and industrial districts of Northern Spain, including the areas around Oviedo, Ujo and Santander. These five stations are Doiras, Salime, Silvon, Suarna, and Arbon. Doiras was built by Electra de Viesgo in 1934 and contains three 18 MVA generating sets, while Salime, at Grandas de Salime, will house four 35 MVA units. Silvon will take its water from the Doiras reservoir, the capacity and head of which are being increased by raising the dam crest by 3 m. Initially, this station will contain one 35 MVA set, but space is provided for a second.

In January, 1949, the English Electric Export & Trading Co. was awarded the contract for the supply and erection at Salime power station of the four main turbine inlet valves, four vertical Francis type turbines with their draught tubes and auxiliary equipment, four 35 MVA alternators, the four main transformers, all 380 V, 11 kV and 140 kV switchgear and the 11 kV power cables between the alternators and the 11 kV cubicles. In November, 1955, the contract was placed with the English Electric Co., Ltd., for the first generating set for the Silvon station. Salime power station was opened by General Franco in August, 1955, and it is at present being used as a peak load station.

The Salime dam is of the arch-gravity type, having a uniform triangular section throughout its length with a slope of 5 per cent on the upstream face and 72 per cent on the downstream face. The dam crest lies on a curve of 400 m radius and its height above the foundation is 131·5 m. The horizontal length of the crest is 250 m and its width is 9 m.

The penstocks for the four turbines are embedded throughout their length in the structure of the dam, each being about 90 m long and having an internal diameter of 2·5 m. Each pipe has an intake screen and an intake butterfly valve, the latter being accessible through a gallery in the dam. At the bottom end, each pipe is connected to a main turbine intake valve.

One of the interesting features of Salime is the design of the spillway, which flows over the power station into a stilling basin. This unusual layout was necessary because of the local topography.

The River Navia flows for the most part in a deep, narrow valley through high mountains, the total catchment area being 1,806 sq km. It is fed by melting snow as well as by springs and rainfall, under which conditions severe floods are to be expected at times, and the Salime spillway had to be built for a maximum flow of 2,000 cu m/sec, despite the fact that the average flow of the river at Salime is only 51 cu m/sec. Therefore, at maximum flow the spillway dissipates about a million horsepower and this must be done in a very narrow valley where there is a danger of landslides, and also avalanches in winter, due to the steep inclination (about 45 deg) of the strata and the slaty nature of the rock.

As there was not sufficient space for the power station

and spillway side by side at the foot of the dam, the power station was placed there and the spillway carried over its roof discharging into a stilling basin. The water slides into this and flows along its bed until turned back on itself by the downstream retaining wall. There is a row of " dragon's teeth " at the meeting point of the spillway and stilling basin so that the water is aerated before entering the stilling basin, thereby preventing cavitation of its floor. The spillway is shaped to give a slight lift to the water as it passes over the power house in order to relieve the pressure at that point.

The surface of the spillway conforms to the curvature of the main dam. For this reason the four generating sets in the power house lie on an arc of 310 m radius. Consequently, the station overhead travelling crane rides on a curved track and has larger diameter wheels on the upstream end than on the downstream to compensate for this curvature.

Three main transverse bays are provided beneath the spillway. The power house occupies the middle bay, the tailwater chamber the bottom one, and the upstream bay houses the main control room containing control, metering and relay boards and all the 380 V switchgear. A platform was made on the left bank of the river alongside the stilling basin to accommodate the four main transformers and the 140 kV switching station.

The water in the tailrace chamber passes through a free flowing tunnel of 7 m internal diameter, running underneath the substation, and discharges into the river just downstream from the counter dam of the stilling basin, thus ensuring stable tailrace conditions.

The layout of the power station follows the normal English Electric one-floor arrangement, in which all parts of the plant and equipment, including the main valves, come under direct access of the crane. The width and height of the power station had to be made the minimum so that the spillway could be kept as low as possible, and by adopting a curved longitudinal horizontal axis instead of the normal straight axis, a considerable saving in these dimensions was obtained. In addition, two important departures from standard machine design were made to keep to the minimum the crane hook height necessary for lifting the rotor out of the stator; the turbine-alternator shaft was divided into three sections instead of the usual two and the pilot exciter was partly telescoped inside the main exciter.

The four main turbines are of the vertical Francis reaction type running at 300 r.p.m., each giving a maximum output of 50,000 h.p. under a net head of 112·5 m. The minimum working net head is 69 m under which conditions each turbine develops 21,000 h.p. Each alternator is rated at 35 MVA at 0·9 power factor 11 kV 50 c/s. The four generator transformers are three-phase units, each rated at 35 MVA and having a no-load ratio of 11/140 kV, the 11 kV winding being delta connected and the 140 kV star connected.

The unit arrangement was adopted for the power station, in which each set normally runs independently of the others and supplies its own auxiliaries at 380 V by means of an 800 kVA unit transformer connected direct to the alternator. The 11 kV switchgear consists of isolators housed in cubicles for isolating each alternator from its main transformer and also for disconnecting the feed to the unit transformer if desired.

Because of the narrowness of the site for the outdoor substation alongside the stilling basin it was essential to use a " high " type arrangement in which the isolators and busbars are vertically above the circuit-breakers, instead of adjacent to them as in a " low " station. The station has duplicate 140 kV busbars. The 140 kV circuit-breakers are of the English Electric air-blast type, with two interrupters in series per phase, having a breaking capacity of 2,500 MVA. All the feeder breakers are provided with high-speed auto-reclose control.

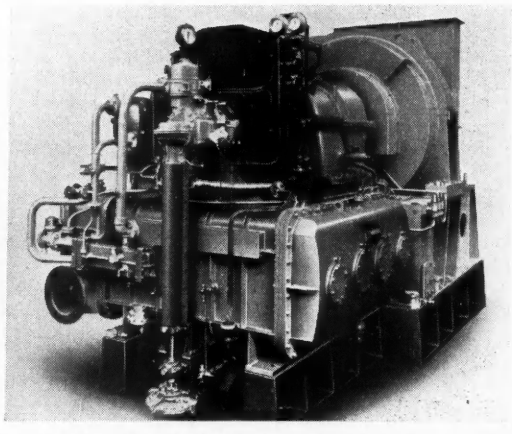
The "Empress of England"

ELECTRICITY for services throughout the new Canadian Pacific Steamship Company's passenger liner *Empress of England* is supplied by two 1,200 kW self-contained d.c. turbo-generators and three 500 kW two-stroke diesel engine driven d.c. generators, all of which were constructed by W. H. Allen, Sons & Co., Ltd.

Each turbo set has a normal full-load output of 1,200 kW, with an overload capacity of 25 per cent for two hours. The turbines, which are designed for a steam pressure of 600 lb/sq in gauge and a temperature of 850 deg F, drive the d.c. generators through reduction gearing with a ratio of 11·65 : 1, the turbines running at a speed of 7,000 r.p.m., and the generators at 600 r.p.m. Each turbine is mounted on its own self-contained surface condenser, designed to give a vacuum, at full load, of 28·3in Hg when supplied with cooling sea water at 75 deg F. The condensate extraction pump is driven through gears off the turbine shaft. The d.c. generators are 225 V machines of the Allen marine forced-lubricated single-pedestal-bearing, compound-wound type, with drip-proof canopy protection over the commutator.

The three Allen diesel-engine-driven generating sets consist of six-cylinder, 755 b.h.p., two-stroke, Type T47 engines (built under licence from Harland & Wolff, Ltd.) directly coupled to 500 kW, 225 V d.c. generators running at 350 r.p.m. The generators, which are of the open drip-proof, single-pedestal-bearing, compound-wound type, are continuously rated and suitable for operating in parallel, both with each other and the turbo-sets.

Two 16/14in Allen motor-driven auxiliary salt-water circulating pumps are installed for the 1,200 kW turbo-generator sets, each being driven by a 35 h.p. 550/810 r.p.m. Allen vertical-spindle d.c. motor. Each pump is capable of delivering 3,500 gal of salt water per minute against a total head of 25ft at the normal speed of 795 r.p.m. The auxiliary pumps, together with variable-speed motors and starters, for the diesel generating sets are also of Allen construction.



One of the two Allen 1,200 kW self-contained d.c. turbo-generators

Large Earthing Systems

I.E.E. Supply Section Paper

IN a paper presented on 27th March before the Supply Section of the Institution of Electrical Engineers, Mr. J. D. Humphries (United Steel Cos., formerly with C.E.A.) discussed earth-electrode systems for modern generating stations and large substations, where earth-fault currents might exceed 5 kA. A satisfactory electrode system, he said, must be capable of dissipating the maximum power-frequency earth currents without damage to life or plant by high potentials, potential gradients and thermal or mechanical stresses. It must also ensure that the impedance presented to high-frequency currents due to lightning did not differ greatly from the power-frequency impedance.

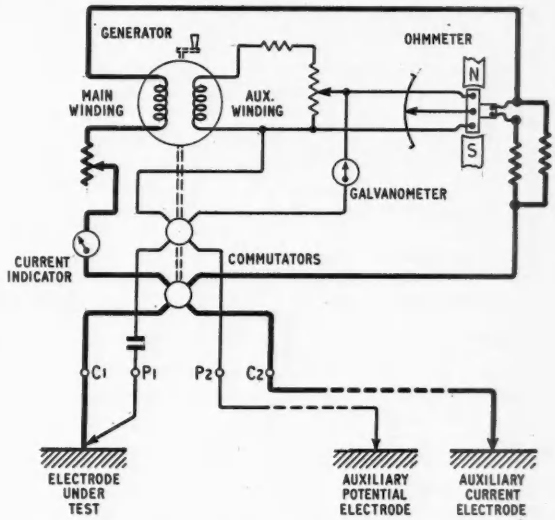
For large stations the inductance of the various interconnections was frequently considerable, compared with conditions at distribution substations covering small areas where the impedance to steep-fronted waves might be virtually the same as the d.c. resistance, so that an appreciable proportion of the total dissipation conductance of the earthing system had to be concentrated at points most likely to be affected by surges. The maximum potential specified by the Post Office for unprotected telephone equipment was 430 V. The earth system must be considered as a complete entity. Connection of one or two isolated electrodes to the main earth busbar via test links was generally inadequate.

Comparative merits of various components of earthing systems were dealt with in three groups, viz., specific earth electrodes, fortuitous earth electrodes and interconnections. Among the first were earth plates which had a great current-carrying capacity but a high dissipation resistance in high-resistivity soils; the small improvement due to association with coke hardly warranted the increased cost of excavation. Small diameter rods were cheap and easily driven into soft ground by a portable electric hammer, especially where a stratum of low-resistivity soil lay at some depth. Bare interconnections could provide most of the dissipation conductance. They were more economical than large cast-iron pipes, but pipes of 1½ to 3in diameter were occasionally used where driving equipment was available on site. Interlocking steel piles used in foundations of large structures were very good, but could not economically be provided purely as electrodes. Metalwork of reinforced-concrete piles should wherever practicable be incorporated in an earthing system, but not prestressed concrete piles whose small reinforcing wires might be damaged by fault currents, thus impairing the strength of the piles.

A long metal strip made efficient use of material in covering a wide area, within its stretchable limits. Current-carrying capacity and longitudinal resistance gave a minimum permissible cross-section of 1 by ⅛in for copper or 2 by $\frac{3}{16}$in for steel, while a.c. (power frequency) impedance normally restricted the economic length to 100 yd. Strips in mesh formations gave maximum usage of the site area with a minimum of material, uniform voltage over the whole area and, generally, low dissipation resistance, but they necessitated access for excavation over the entire site and a high expenditure on jointing.

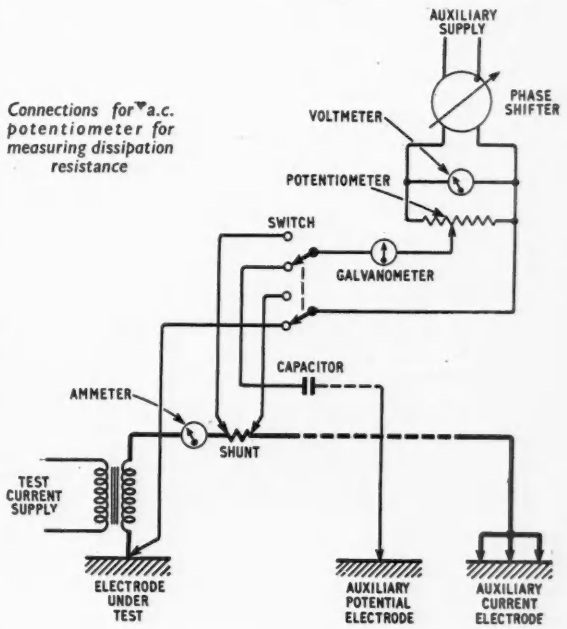
Continuous earth wires on overhead lines earthed at every pole could help to reduce dissipation resistance if bonded to the earth electrode system, but their high reactance limited their utility. Among fortuitous earth electrodes (i.e. those not designed as such) were cables with jute servings which when saturated allowed the metal sheathing or armouirng to be in effective contact with the soil.

Water pipes bonded to the earth electrodes often tended to equalise potential gradients within the station, but the transfer of large currents and high potentials away from the station was undesirable. Where possible asbestos



Circuit diagram for geophysical earth-tester ohmmeter

Connections for a.c. potentiometer for measuring dissipation resistance



cement or other insulating material should be used for the service connection of a town water main. If metal in a structure formed part of the earthing system, the drying out of the soil might invalidate measurements. Miscellaneous interconnections spread widely over the site formed an important part of an earth-electrode system. The design of earthing systems for substations was usually more difficult than for generating stations, mainly owing to their smaller site areas, while fault currents were often as high, making rod, strip or mesh electrodes desirable in conjunction with all fortuitous earths.

For measuring low values of dissipation resistance a modified geophysical earth-testing ohmmeter with separately mounted generator possessed overall sensitivity, giving a full-scale deflection on the bottom range for 0·3 ohm. Errors were possible due to faulty commutation in large stray potential fields and from incorrect measurement of reactive systems. An alternative was the injection of 50 c/s a.c. by connecting the source to the electrode to be tested and to an auxiliary current electrode. A variant developed by E.R.A. used a.c. at 30 c/s, which was sufficiently separated from the system frequency to permit filter networks for differentiating between them and avoiding interference from stray potentials.

A three-phase injection method was described and also a sensitive potentiometer device that did not entail the use of all three phases and discriminated against interference from large stray potentials. For large installations it was never sufficient to determine dissipation resistance by only one measurement. A complete survey of the potential distribution in the vicinity of the station was desirable. The design principles recommended were applicable also to areas of low soil resistivity, where they could effect economies in the use of material. Acknowledgment is made to Evershed & Vignoles, Ltd., in respect of certain information and diagrams in the paper.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

A LARGE mass of statistics has been assembled over a period of about 15 years on the lightning safety of overhead lines from 35 to 220 kV protected by earth wires, and the results of the evaluation of these data are now reported. The most striking fact is that the total number of outages was a minimum on 220 kV lines and that they were all cleared by reclosing, being simple single-phase faults. Almost as satisfactory were the conditions on 150 kV lines.

A great difference existed between the frequency of outages on 110 kV lines, throughout on metal supports, on the one hand, and 110 kV lines on wooden poles or on mixed wooden and steel supports. The numbers of outages in these cases were 33, 4 and 5, respectively. The relation between wood and metal-supported 35 kV lines was similar. Two-phase faults not involving earth occurred only on metal-supported 35 kV lines. The most important result obtained was the confirmation of the author's prediction that a protective angle of the earth wire of 20 deg affords practically complete protection against lightning strokes to the conductor. The results obtained are in good agreement with American and German observations.—" Investigation of the Atmospheric Surge Protection of Transmission Lines with Earth Wires," V. V. Burgsdorf, *Elektrichestvo,* No. 11, pp. 8-14, 1956, in Russian.

Varnished Copper Wires

Copper wires insulated by varnishes on p.v.a., polyamide, epoxy resin and terephthalic acid polyester bases have been subjected to artificial ageing in stoves heated by circulating hot air. The specimens were either straight, and afterwards used for coiling tests, or twisted (stranded) wires which were then used for measurements of the breakdown voltage of the insulation. If the life of the wire finds a natural conclusion by the thermal expansion of the copper conductor, the test results are easily reproducible and can be used to obtain characteristics of the service life which are susceptible of analytical representation. This ensures that extrapolations in the range of lower temperatures are trustworthy and accurate enough. Thick varnish coats prolong the service life of the insulation in a higher than linear proportion with the increase in thickness. The method described and results obtained will facilitate the temperature classification of insulation materials and supplement the methods already stipulated by various national regulations.—" A Contribution to the Determination of the Life of Varnished Copper Wires," O. Beel, O. W. Romm and H. Luthardt, *E.T.Z.(A),* Vol. 77, No. 22, pp. 829-834, 11th November, 1956, in German.

Removing Electrostatic Charges

The industrial dangers of electrostatic charges set up in processing fibrous materials, such as textiles, paper, etc., are now well known and in some cases they are greatly aggravated by the simultaneous presence of inflammable or explosive atmospheres. This is particularly the case in the rubber industry, viz. on rubberising machines. The only method of practical consequence for neutralising these static charges is to keep the air ionised by a constant ionising agent. The author finds at first theoretically the required density of the ionising current required above a tissue moving at a given speed, and the necessary height of the ionised air layer to remove safely all the charges generated by friction. From this the intensity of the ionising agent can be found if recombination coefficient and mobility of the ions are known.

The practical problem is in the choice of a sufficiently powerful and harmless ionising agent since, for example, gas flames, ultra-violet and X-rays are obviously too dangerous by themselves to be used near rubberising machines (ultra-violet radiation is, furthermore, unsuitable for removing the positive charges set up on these machines). Practical tests as well as theoretical considerations have shown that only h.f. h.v. fields solve the problem satisfactorily without introducing additional dangers.—" Removal of Electrostatic Charges by Ionising the Air," V. N. Egorov, *Elektrichestvo,* No. 12, pp. 43-48, 1956, in Russian.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review.*

ELECTRICITY BILL

Committee Stage Concluded

WHEN consideration of the Electricity Bill was resumed by a committee of the House of Commons last week Mr. Fort moved a new Clause which provided that every Area Board should as soon as practicable after the passing of the Act, fix maximum prices at which electricity supplied by them might be resold. He said the proposed Clause originated in representations made for a number of years by the North Western Consultative Council which had received complaints that the tenants of flats and other sublet premises had been charged exorbitant rates for electricity by their landlords.

Figures supplied showed that profits as much as 500 per cent had in certain cases been made. The new Clause, which was practically word for word the same as the relevant section of the Gas Act with the substitution of "electricity" for "gas," would remove a very real injustice.

Mr. Robens, for the Opposition, supported the new Clause.

Mr. David Renton, Parliamentary Secretary, Ministry of Power, acknowledged that a good case had been made out for doing something about this problem, which related mainly to the North West. Only in the case of two other Boards had the problem become at all acute. If Mr. Fort would withdraw his Clause the Government would put down an amendment which would be appropriate to the circumstances of the electricity industry, which in this case were somewhat different from those prevailing in the gas industry. For that reason they could not precisely follow the wording of the appropriate section in the Gas Act.

The new Clause was, by leave, withdrawn.

Mr. Palmer moved a new Clause to provide that the Electricity Council, the Generating Board and the Area Boards should be deemed to be parties to any agreement entered into by the Central Electricity Authority and the Scottish Electricity Boards before the vesting date and subsisting at that date with any organisation in pursuance of the Authority's duty under the provisions of Section 53 of the principal Act. He said they were anxious to ensure that the agreements made with the existing employers and managements would be continued until such time as, in consultation with the unions, the managements made new agreements.

Mr. Reginald Maudling, Paymaster General, promised to put down an amendment on the report stage to carry out the intention expressed by Mr. Palmer, with which he said the Government entirely agreed, and the new Clause was, by leave, withdrawn.

Local Authority Representation

On the First Schedule ("Consultative Councils"), Mr. Palmer moved an amendment to maintain the existing local authority representation. The Opposition took the view, he said, that Consultative Councils should protect the interests of the domestic consumer first and foremost, because the larger interests were so well organised that they had plenty of opportunity of putting forward their views.

Mr. Renton explained that the intention was to give greater flexibility. Broadly speaking, the Government would maintain the general preponderance of local authority representation on each of the Consultative Councils and would not, as a general rule, reduce local authority representation to the permitted minimum. They would on the whole keep it at the maximum. But in those areas where there was a preponderance of industrial consumption—in one area at least it was 75 per cent—the Government felt there should be a greater industrial representation.

Mr. Palmer intervened to ask if that meant that the Government were going to take these powers, but in the main were not going to use them.

Mr. Renton confirmed that that was the position. They would use these powers only in those cases where it was obviously right to do so.

Mr. Alfred Robens said he did not understand why it was necessary to make any changes in the principal Act. The flexibility, said to be required, was already there, and there were sufficient places on the Consultative Councils to provide for all the various interests being adequately and properly represented. While he accepted the Government's undertaking, it was the duty of Parliament to draw up Acts so that no change could be made without the consent of Parliament. Representation should not be apportioned on the basis of electricity consumed. He urged the Parliamentary Secretary to reconsider the matter.

The amendment was carried to a division and rejected by 18 votes to 13.

On the motion that the First Schedule should stand part of the Bill, Mr. Hayman said the establishment of Consultative Councils had been a great experiment in democracy and had proved worth while.

Publicising Consultative Councils

Mr. Burden welcomed the information that funds would become available to the Consultative Councils, if necessary, to publicise the work they were doing. Because of lack of publicity far too few of the consuming public were aware of the Councils' powers. There was some concern because offices of the Councils were at the offices of Area Boards and he asked the Minister at least to advise that where possible the two offices should be apart.

Mr. Niall Macpherson, Under-Secretary, Scottish Office, said the Government agreed about the importance of the independence of the Councils. The point about whether the Council should occupy private office accommodation was a matter for local decision.

The First Schedule was agreed to.

On the Second Schedule ("Transitional Provisions") Mr. Maudling moved an amendment to change the tariff provisions of the Bill because of the change in the vesting date from 1st April to 1st January, 1958. The amendment proposed that the tariff fixed on 1st April, 1957, should run through until 1st April, 1958, and be applicable for the first three months of the new operation as it was for the last nine months of the old.

The amendment was agreed to.

Mr. Maudling moved an amendment to leave it to the Electricity Council to agree, subject to the approval of the Minister, with the Generating Board and the Area Boards a proper scheme for the distribution of the industry's assets and liabilities.

The amendment was agreed to.

Mr. Maudling moved another amendment to provide that the Electricity Council should have the responsibility

for preparing a scheme, subject to the Minister's approval, for the distribution of the central reserve fund among the Generating Board and the Area Boards. The distribution of the fund would have the effect of reducing the capital liabilities which would otherwise fall upon the various Boards.

The amendment and the Second Schedule were agreed to.

On the Third Schedule (" Amendment and Adaptation of Enactments ") Mr. Maudling moved an amendment to provide that the responsibility for unclaimed compensation stock was transferred from the Central Electricity Authority to the Electricity Council. He said that a small amount of compensation stock remained to be issued because the people entitled to it had not yet been identified. The amendment was agreed to.

Mr. Palmer moved a Labour amendment which required the Electricity Council to prepare in respect of each financial year a consolidated statement of the accounts of the Electricity Council, the Generating Board and the Area Boards in such a form as the Minister, with the approval of the Treasury, might direct. He said such an account existed already in the form of the annual report of the C.E.A. It would cause great inconvenience to students of the industry, to M.P.s, and the Select Committee on Nationalised Industries if the practice was ended.

Mr. Maudling said the suggestion was helpful and useful and he would be glad to accept it in principle. He would like to consider it again from the drafting point of view and would put down an amendment to achieve the desired purpose on the report stage of the Bill. The amendment was, by leave, withdrawn.

Mr. Niall Macpherson moved an amendment to empower the Scottish Electricity Boards to make bulk supplies of electricity to the Generating Board and to people outside Great Britain. The Boards, he said, might want to give supplies either to Northern Ireland, Norway, or, perhaps, even Iceland.

Mr. Palmer suggested that the idea of supplying electricity to Norway was a definite example of taking coals to Newcastle. There must be power for future interconnection, possibly between Scotland and Northern Ireland or even Norway. But if there was any interconnection with Norway most electricity would be imported, not exported. Was the inward movement of electricity, as well as the outward movement, covered?

Mr. Macpherson assured him that the Scottish Boards already had powers to acquire electricity from persons outside Great Britain.

The amendment and both the Third and Fourth Schedules were agreed to.

Mr. Maudling thanked Sir Leonard Ropner for the way in which he had performed his duties as chairman. Mr. Palmer added the Opposition's thanks and said that his interpretation of the rules of order had enabled a reasonable flexibility to be maintained which had greatly aided the committee's work.

It was agreed that the Bill as amended be reported to the House. The committee had taken 14 sittings and Mr. Maudling had undertaken to table a number of amendments to the Bill on the report stage.

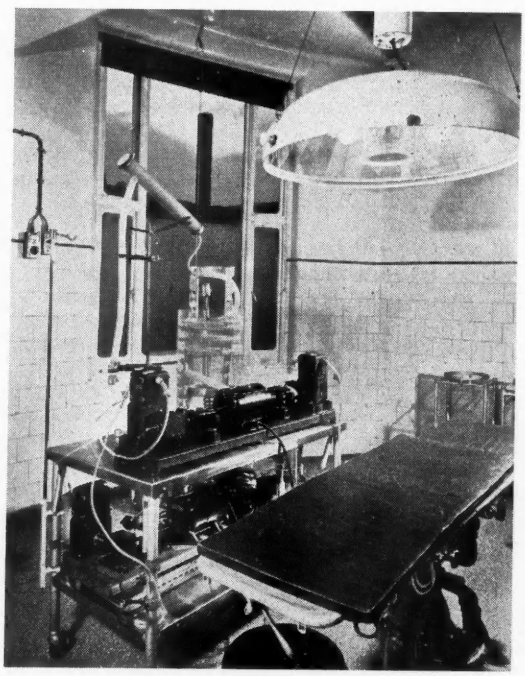
Heart-Lung Machine

SUCCESSFUL operations on the heart have been performed at Guy's Hospital using the Lillebei pattern bubble oxygenator which takes over from the heart for periods up to 20 minutes.

The apparatus, built by Guy's Hospital Thoracic Research Unit, follows closely that developed by Lillebei in the United States. It has the advantages of simplicity and facilities for manual operation in the event of an electrical failure, and it can be built for about £500. The pump unit has been supplied by American manufacturers, but the heating apparatus to keep the blood at constant body temperature has been developed by the General Electric Co., Ltd.

During an operation, the patient's circulatory system is first stabilised through the oxygenator, then the heart is arrested. Once the heart ceases to beat the oxygenator takes over completely. The pump machine " milks " the blood, by means of metal fingers, from the venous end of the heart into translucent tubing which is receiving oxygen. Blood from the coronary sinus is also pumped separately into the main circuit. The blood passes through a " defoamer " to eliminate bubbles, and is then passed along a 12ft length of the translucent tubing which is wrapped round a frame of spacers at predetermined intervals. The spacer frame with the translucent tubing is situated in a " Perspex " tank containing nine gallons of water, which is kept at a constant temperature of 37 deg C by means of a special element controlled by a hot-wire switch. The oxygenated blood, having passed through the tank and warmed to body temperature, is " milked " into the left subclavian artery by another variable geared pump machine using the same motor drive as the first pump.

The 750 W heater element, which is wound in a spiral to give even heating, is 100in in length and is placed concentrically in a nickel-plated copper sheath.



The Heart-Lung Machine installed at Guy's Hospital

INDUSTRY AND THE HOUSE

The Electricity Bill, Nuclear Energy Programme, and Technical Education

By A. M. F. PALMER, A.M.I.E.E., M.Inst.F., M.P.

AFTER fourteen sittings spread over seven weeks the Electricity Bill has completed the Committee Stage in the Commons. This is certainly longer than the Government may have anticipated, but it is not easy for them to complain about undue garrulousness on the part of Honourable Members. The truth is the Bill is a complex measure with a lot of " meat " in it. Debate in any case has been undertaken by a minority on both sides, although several of the silent have told me that they have enjoyed the discussions as being generally of a constructive and useful kind. This may be, of course, the kind of parliamentary courtesy which we are wont to use among ourselves in order to compensate a little for the asperity of our public comment, but I think everybody has learned something as we have progressed, including the Ministerial bench.

Representation on the Electricity Council

It is evident now that the Electricity Council cannot remain the shadowy body that the first draft of the Bill seemed to propose. In response to Opposition pressure the Government has agreed already to strengthen the outside and the generation side representation; in addition as we have proceeded odd tasks here and there, such as responsibility for sharing out the reserve fund as well as for carrying on several " tidying-up " jobs connected with the nationalisation change in 1948, have been given to the Council. Also Mr. Maudling's promise that the scheme for joint consultation will be set up in the first instance by the Council means that it will have to be a solid body with an expert, if limited, staff. And why not? After all, this modest centralisation is in keeping with the tradition of electricity supply ever since the end of the first world war. Even before nationalisation when there was no lack of local executive control, for it was spread over hundreds of separate undertakings, the Electricity Commissioners performed for the industry as a whole several tasks which would not have been done at all otherwise.

Unless Conservative back benchers carry their threatened revolt on the Treasury guarantee to unusual lengths, it is probable that the Report Stage and Third Reading of the Bill could be carried through in a single day on the floor of the House. Points which the Opposition are likely to press further are the desirability of the Electricity Council having stronger powers in relation to capital expenditure by the industry and the need for someone with a labour relations background on the Council. It is a curious feature of the Bill that in appointments for the Generating Board and the Area Boards the Minister must take into account experience of labour relations, but for the Council, which has the primary responsibility for the wage and salary machinery, he is under no such obligation.

Apart from these matters it seems likely that the chief delight of Labour Members at Report Stage will be to offer Ministers support against the attacks launched on them from behind. This state of affairs seems to bear out the correctness of the Opposition's instinct in not opposing the measure, as such, for the changes are in the main in accordance with moderate opinion on both sides of the House which accepts that nationalisation for electricity supply has come to stay and must be made as effective and efficient as possible in the light of experience.

On Friday Mr. Ben Parkin, who sits as Labour Member for Paddington North, moved a private Member's motion that the House welcomed the announcement of the expanded nuclear energy programme and considered that in view of this development there was a greater need than ever for scientific and technical education to be expanded with maximum speed. In the course of a long speech he argued that the nuclear power programme must mean reassessing the estimated numbers of scientists and technologists on which previous Government pronouncements had been based. He thought, in particular, that the sandwich course proposal needed thorough re-examination. The number of students likely to be organised in this scheme would in no sense meet the demands of industry. Also, the whole teaching of mathematics at every level of the educational system needed to be thoroughly examined for this subject was the key to intellectual eminence in the scientific and technological field and we were already falling behind because of an obsession with " art for art's sake." Mr. Parkin's motion was seconded by Mr. Austen Albu, one of the few professional engineers in the House, who pointed out that the planning of investment included the planning of human as well as physical resources. In a reference to the colleges of advanced technology, he thought that many of the local authorities would not be able to do financially what was expected of them unless a more generous system of grants was adopted by the Government.

Education for Industry

In one of the most eloquent speeches I have listened to from him Mr. Geoffrey Lloyd, the former Minister of Fuel and Power, made a strong plea for the Government and public opinion generally to regard an improvement in education for industry as a first charge on the national effort. Among Mr. Lloyd's many practical suggestions was for a sandwich course of two to three years' duration which would lead to a national diploma for technicians.

The debate in general took a sedate path with Mr. Peart intervening officially for the Opposition and the Parliamentary Secretary to the Ministry of Education, Sir Edward Boyle, giving a vast amount of detailed information on the Government's plans in reply. However, before it ended Lord Hinchingbrooke, who had put down an uncalled amendment to the motion, in a short speech took a surprisingly unorthodox line. The noble Lord's contention was that the Russian threat both in the military and the technological sense had been vastly overestimated. He thought it was convenient for the vested interests of engineers and technologists to play a subtle part in influencing fears of foreign competition overwhelming us in order to obtain approval for their grandiose schemes of capital development. In an aside he promised the House on a later occasion to analyse what he called the " fascinating " influence of scientists and technologists upon the mind of the Labour Party. His general thesis

seemed to be that if a small island community tried to emulate the optimum standards of technical progress of every other country then it would not escape from the "most terrible inflation." This is what he called a "sociological argument against too great a massive scientific advance."

By means of adroit questioning Members are finding out more and more about the details of the expanded nuclear power programme, but a comprehensive White Paper is still badly needed. If such a document comes along then the pressure for an all-day debate will be very great and it is hard to see how the Government can refuse time.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Opportunities in Electrical Contracting Industry

"REFLECTOR," in his reference to the fixed rate of pay which applies to the electrical contracting industry, appears to have lost sight of the provision in the national working rules which permits the payment of more than the standard rate to any particular employee or employees selected on the grounds of special ability or responsibility or long service.

This provision clearly provides an inducement on the lines indicated by "Reflector." It is equally obvious that an operative possessing skill will very quickly assume the position of chargehand and will be remunerated accordingly.

It is unnecessary, of course, to add that the electrical contracting industry provides ample scope for further advancement to those who will acquire greater technical knowledge.

London, W.C.1. L. C. PENWILL,
Director and Secretary,
National Federated Electrical Association.

The International Ohm

MAY I be allowed to use your space once more to correct the erroneous impressions of not only those who have replied through these columns but also those who approached me privately both through the Editors and direct. The facts are: mercury as required for the International Ohm is very much a non-linear conductor and its construction as specified is virtually impossible.

I have been very surprised at the great number who hold mistaken impressions but it is no doubt due to the fact that most textbook figures are incorrect, as daily contact with and years of research on allied problems has shown us.

It is impossible in the space of a single letter to deal fully with all the practical and theoretical problems involved in the construction of the mercury ohm. One can quite appreciate that in the early years these problems were not recognised, for even to-day some are not fully understood and remain unsolved. Very close results can be obtained—using a correct current relationship—and all trouble with the terminations eliminated by not adhering strictly to the specifications, but in the construction of any standard it is of course necessary to split hairs.

E. J. BEAVEN.

Open Space Lighting

IN a paper presented at a meeting of the Illuminating Engineering Society in London recently Messrs. M. W. Peirce and H. F. Stephenson dealt with the lighting of outdoor open spaces for industry, transport and sports. One feature common to all such lighting, the authors stated, was that the contrast between the light source and its background was almost certain to be excessive when compared with ordinary standards of interior lighting. The background luminance was not under the control of the lighting engineer, and all he could do to limit the luminance range within the field of view was to control the intensity distribution and cut-off angle of the fittings, limit the maximum source luminance, or choose positions for the light sources which keep them away from the line of sight.

It was frequently necessary to choose between a system using a large number of low mounted fittings or floodlighting from high towers with a smaller number of powerful projectors. Often the latter method produces the more effective and neater looking installation, but towers were expensive. There was no simple set of rules which would determine how an area should be lit, and in general either method was possible.

In some places the physical conditions would impose a decision, in others an analysis of the relative costs of fittings and cabling might be found to offset the expense of towers. Floodlighting installations of comparatively low mounting height, say 40-50ft, tended to be cheaper but more glaring than those using a large number of smaller sources. Glare was reduced in floodlighting schemes as the height of the supporting structures was increased, but this increased the cost. The most economical scheme which would provide satisfactory working conditions could only be decided after a study of the specific circumstances of each installation.

The illumination distribution required for most space lighting applications rarely needed to be uniform. The reflection characteristics of the surfaces to be lit varied widely from one site to another and often the illumination on vertical planes might be more important than on the horizontal. Again, in sports lighting not only was the horizontal playing area to be well lighted, but also vertical surfaces on the players and objects in the air, such as a football. Unless the problem could be precisely defined there was no simple theoretical basis for design, but experience had shown that for most jobs diversities of perhaps 5 : 1 were acceptable provided the changes in illumination were smooth. Similarly, the ratio between illumination on horizontal and vertical surfaces at any point might vary considerably provided it does not change rapidly. A compromise could usually be found for uniformity of illumination on vertical and horizontal surfaces and if glare was restricted an acceptable visual appearance was produced.

At low mounting heights any of the available light sources might be used unless colour was important. Fittings using symmetric specular reflectors could provide good uniformity for spacings up to about $2\frac{1}{2}$ times the mounting height and where some diversity could be tolerated less critical and lower priced vitreous enamel reflectors were used. At high mountings much greater intensities were needed and a compact bright light source was necessary, which in practice almost always meant a filament lamp. Specular reflectors such as paraboloids were used to give a more concentrated distribution, but covering only a restricted angle in azimuth. A wide range of divergencies could be obtained and with fluted or prismatic front glasses additional spread in one plane. Light above the beam centre often caused glare and, with long throws, might be wasted in lighting the air. It might be partially controlled with visors or spill rings. Special optical designs could be used to obtain a rapid run back above the beam centre, but at the expense of peak intensity. Such designs were very suitable for intermediate throws. Precise light control in the vertical plane could be achieved with linear light sources such as horizon type filament and horizontal burning h.p.m.v. lamps in trough reflectors.

VIEWS on the NEWS

By REFLECTOR

BENJAMIN FRANKLIN was the pioneer of many odd electrical inventions and my indefatigable researcher into the remote electrical past has discovered that one of these was the humane killing of poultry. The method is described by this great philosopher and electrician in a letter dated 4th February, 1750, in the archives of the Royal Society. In this he says that he had killed turkeys by " electrical strokes " and had made several experiments on killing fowls during that winter by electricity. He continues:—

> " We found two large thin jars, gilt (holding each about six gallons, and taking 2,000 turns of a globe of nine inches diameter to charge them full, when the globe works very well, and will charge a common half-pint vial with 50 turns) were sufficient to kill common hens outright; but turkeys, tho' thrown into violent convulsions, and then lying dead for some minutes, would recover in less than a quarter of an hour."

By the use of five jars, however, he could kill a turkey up to 10 lb and much larger. Franklin was also of the opinion that birds killed by electrical strokes " eat uncommonly tender."

* * *

At the Electrical Wholesalers' dinner last week Professor D. R. Seaborne Davies told of a professor of economics who was observed preparing an examination paper. The questions were seen to be the same as in the previous year and when asked whether this was wise the professor replied:—" Oh yes! Conditions have changed since then and all the answers are different."

* * *

There has again been an outbreak of headlines in the daily papers about " engineers " who are members of the trade unions involved in the current wages dispute. Among them *The Times* has erred, a fact which one correspondent finds " deplorable and disappointing." He says:—

> " Even *The Times* can no longer resist the easy and convenient misuse of words of specific meaning, so fostering the misunderstanding and confused thinking which is so adequately catered for by less accurate and reputable publications."

He goes on to explain that " an engineer is a man qualified in his profession in precisely the same manner as a physician, a surgeon, a solicitor, a barrister or an accountant."

* * *

Away back in July last year, noting a report that clerical staffs were being required to have " a knowledge of electricity and an understanding of machines because of automation and mechanisation," I suggested that it would be some time before we saw advertisements for engineer-typists or shorthand-electricians. This was picked up by the New York *Electrical World* and now (quoted from that journal) it has appeared in an English house magazine with the comment:—" You see the trouble we go to to keep you up to date. We read American journals to find what British Editors have to say." How much better (and how much more up-to-date) it would be to get it from the source.

* * *

There are, of course, many good reasons why people adopt electricity rather than gas but the *Leicester Evening Mail* has found another which is quite new to me. It says:

> " Because there is a shortage of gas fitters in Market Harborough, the local council will, perhaps, be forced to install electricity only in their new houses and flats."

* * *

A correspondent, whose identity and habitat must remain secret, sends me the following extract from a letter received from an Electricity Board:—

> " Your letter of 4th February has now reached me, and I have noted your interesting suggestion that the method of calculating unit charges should be revised. I can agree that the revision you propose would result in lower charges for electricity supply to . . .; unfortunately, I cannot offer to follow your suggestion. I can confirm that the method followed in preparing our December account is quite correct because the charges, although perhaps a little confusing, are intended to be that way."

The last sentence will confirm what many people have long suspected about some Boards' accounts.

* * *

All visitors to Moscow are shown the " Metro," the city's underground railway of which the Russians are extremely proud—and apparently with good reason. A delegation of British miners were evidently impressed because, according to a report in *The Times* they gave voice to the following strange opinion:—

> " The mosaics of the Moscow Metro are as splendid as many so-called roads are non-existent."

* * *

Some astringent comment in the *Electrical Review* of 25th March, 1887, followed the virtual rejection of a scheme for an electric tramway in Littlehampton by Major-General Hutchinson, a Board of Trade inspector. General Hutchinson said that until more was known of electricity as a means of motion he could not recommend the Board of Trade to consent to the scheme. The *Review* said that the inspector

> " is evidently imbued with a strong dislike of progressive science. . . . Perhaps, like Rip van Winkle, the gallant inspector has been indulging in a protracted period of somnolence, and this theory is rather supported by his avowal that he is 'very much in the dark' regarding electricity as a motive power. . . . Everyone ought to know by this time, even Government inspectors, that the utility of electricity as a motive power has been well established at Brighton, Portrush, Blackpool, Ryde, and numerous places on the Continent of Europe and in America."

PERSONAL AND SOCIAL

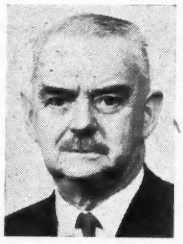
News of Men and Women of the Industry

The Minister of Power has reappointed **Colonel Sir Stuart Mallinson,** C.B.E., D.S.O., M.C., D.L., J.P., of Woodford Green, Essex, and **General Sir Frank Simpson,** G.B.E., K.C.B., D.S.O., D.L., J.P., of Great Warley, Essex, as part-time members of the Eastern Electricity Board.

Sir Reginald Wilson, chairman of the Eastern Area Board of the British Transport Commission, and a member of the Transport Commission, is the new president of the Institute of Transport.

Major L. H. Peter, M.C., A.F.C., M.I.E.E., has been elected president of the Radio and Electronic Component Manufacturers' Association. Major Peter has been associated with the Westinghouse Brake & Signal Co., Ltd., for many years and since 1947 has been chief development engineer of the company.

Mr. R. Arbib, chairman and managing director of Multicore Solders, Ltd.,



Major L. H. Peter

Mr. R. Arbib

has been elected chairman of the R.E.C.M.F. He entered the radio industry in 1929 in the Electrical Reproducer Department of H.M.V., later becoming advertising manager of that company. During the last twenty years he has been largely responsible for the development of Multicore Solders, Ltd.

Mr. F. H. Roberts has been appointed a director and chief engineer of John Thompson (Australia) Pty., Ltd., a member company of the John Thompson Group. Mr. Roberts has played an important part in the development of power station plant using Victorian brown coal and New South Wales black coal and briquettes. He was mechanical engineer of the State Electricity Commission of Victoria, whose service he joined in 1923 after undergoing a special training course in the Electric Supply Department of the Melbourne City Council. In his capacity first as combustion engineer, and later as mechanical engineer to the Commission, Mr. Roberts was responsible for the design, technical construction and the bringing into service of power stations, briquetting works, open-cut equipment and general mechanical engineering plant. He was sent abroad by the Commission in 1951 to deal with design matters for the Yallourn power station plant and to carry out investigations into power station development in England, Germany and the United States. Mr. Roberts was largely responsible during the last war for the design and engineering work undertaken by the Commission for the Commonwealth Government in generation and the supply of heat to the gun cotton factory, Ballarat; the pyrotechnic section at Maribyrnong; and the Salisbury explosives works in South Australia. He is a member of the Institution of Engineers (Australia) and a Fellow of the Institute of Fuel.

Mr. D. Youdan, who, since November, 1950, has been manager of the Daventry District of the East Midlands Electricity Board, has been appointed manager of the Bletchley District as from 1st April.

Mr. F. J. Lane, deputy chief engineer (transmission), and **Mr. J. W. H. Dore,** plant design engineer, of the Central Electricity Authority, left last week for the United States where they have been invited to present papers to the American Power Conference in Chicago (27th-29th March). The title of Mr. Lane's paper is "The 275 kV System of the Central Electricity Authority in the United Kingdom" and Mr. Dore's "Recent Power Plant Developments in the British Electricity Supply System." After the conference Mr. Lane and Mr. Dore will tour the United States and Canada for an exchange of views with American and Canadian engineers.

Merz and McLellan are taking **Mr. W. W. Campbell** and **Mr. A. W. Pedder** into partnership, with effect from 1st April. Both have been senior members of their staff for a number of years. Mr. Campbell will normally be based on their Newcastle Office and Mr. Pedder on their Esher Office. As from the same date **Mr. T. G. N. Haldane** is retiring from partnership as he wishes to devote an appreciable amount of time to his private interests in Scotland. He has, however, agreed to continue his connection with the firm as a consultant.

Among four special annual awards made by the City and Guilds of London Institute under its Insignia Award in Technology (C.G.I.A.) scheme is one to **Mr. F. Limb** (Ericsson Telephones, Ltd.) for his work in telecommunications, and another to **Mr. J. Loxham,** M.I.Mech.E. (Sigma Instrument Co., Ltd.), in respect of his work in precision engineering.

The concert given at the Central Hall, Westminster, last week by the **Lessa Music Society** (London Electricity Sports and Social Association) was notable for the performance of a young man, Roger Fisher, who at a few hours' notice stepped into the breach caused by the sudden indisposition of Douglas Sharpe and played the organ in Guilmant's Symphony in D minor (for organ and orchestra). Roger Fisher displayed the mastery and confidence of one of more mature years, and he fully deserved the ovation which was accorded him. The programme opened with Elgar's "Pomp and Circumstance No. 4," in which it seemed to us the orchestra lacked emphasis, but in Prokofieff's musical tale "Peter and the Wolf" which followed, the playing, under the direction of Leslie Atkins, was delightful and Nona Baker, the narrator, gave point to the musical illustration. The first half of the programme concluded with the symphony, and here again the orchestra was in fine fettle. The second half was given over to excerpts from Edward German's "Tom Jones," in which choir and orchestra combined to make a harmonious whole. It was pleasing to hear the familiar tunes once again, and Margaret Wilby and Norman Fearing, the soloists, were in good voice.

Lord Colyton, P.C., C.M.G., has been appointed a director of Metal Industries, Ltd. Owing to increased demands on his time, **Mr. J. T. Rymer** is resigning from the board.

Mr. C. T. W. Sutton, M.Sc.(Eng.), M.I.E.E., A.M.I.C.E., A.M.I.Mech.E., who writes in this issue (page 551) on "E.H.V. Power Cables," is an associate director and chief engineer of Enfield Cables, Ltd. He has been for many years closely associated with the progress of the transmission of electrical power at high voltages, especially by underground cables. He has contributed to the development of cables employing a high gas pressure, in particular in the design of the compression cable system. He is a member of a number

Mr. C. T. W. Sutton

of technical committees associated with the C.E.A., C.M.A., I.E.E., etc. Mr. Sutton was co-author of an I.E.E. paper on the flat pressure cable which was awarded the Ferranti Premium for 1956.

On 1st April the Ashford and Folkestone Districts of the South Eastern Electricity Board are to be amalgamated. The new District, serving over 40,000 electricity consumers, will be under the existing management until 31st May when **Mr. P. V. Gurr**, J.P., Folkestone manager, will retire and **Mr. D. B. R. Roberts**, A.I.E.E., the present Ashford manager, will take over full control.

Mr. D. B. R. Roberts

Mr. Gurr's retirement will end 50 years' association with Folkestone's electricity supply which began in 1906, when he was transferred from the Town Clerk's office. He was commercial manager of the Folkestone undertaking and of a group of companies in South East Kent before being appointed Folkestone district manager under "Seeboard" in 1948.

In addition to being a magistrate, Mr. Gurr has been very active in local affairs. He is chairman of the Folkestone Trustee Savings Bank, a member of the Rating Appeal Tribunal, and a member of the East Kent Branch of the British Productivity Council. He is a past-president of the Folkestone Rotary Club and past-chairman of the Folkestone Chamber of Trade, and he was a founder member of the National Joint Board for the Electricity Supply Industry.

Mr. Roberts was born in London and educated at Gillingham (Dorset) Grammar School and Northampton Polytechnic, London. He entered the electricity supply industry in 1928 after service in the power department of London's Underground Railways. In 1929 he was appointed mains assistant with the South Metropolitan Electric Tramways & Lighting Co. at Sutton and became successively mains engineer, protective engineer and substations engineer after the electricity distribution side of the company had been taken over by the London and Home Counties J.E.A. With "Seeboard" he served at the Surrey area headquarters, near Dorking, as a planning engineer and at Woking as district commercial engineer before being appointed Ashford manager.

Mr. N. L. Bond-Williams has been appointed an additional director of Enfield Rolling Mills, Ltd.

Mr. L. D. St. James, export sales manager of Morphy-Richards, Ltd., left for South America on 18th March on a two months' sales tour. He took with him a 22 carat gold plated model of the Morphy-Richards "Senior" iron. Insured for £2,000, it is the ten millionth iron to be made by the company.

The Minister of Power has appointed **Lt.-Col. A. J. A. Schofield**, A.M.I.E.E., of Hastings, as a member of the South Eastern Electricity Consultative Council. **Councillor W. B. Adams**, M.I.E.E., of Hassocks, has ceased to be a member of the Council.

Councillor W. P. Hampson, A.M.I.E.E., has been appointed a member of the East Midlands Electricity Consultative Council with effect from 1st April. **Mr. A. Brookes**, M.Eng., M.I.E.E., of Beeston, Notts., retires from the Council on completion of his term of office on 31st March.

The annual presentation concert given by the **Telcon Social and Athletic Club** (Telegraph Construction & Maintenance Co., Ltd., and Submarine Cables, Ltd.) was held on 21st March in the canteen at Telcon Works, Greenwich. Sir John Dean, chairman of the company, presented trophies and prizes to the winners who were introduced by Mr. W. R. J. Martin, chairman of the Club General Purposes Committee and personnel manager. Gold watches were presented to ten members with over forty years' service and clocks and certificates were presented to two members with over twenty-five years' service. Among those present were Mr. W. F. Randall (managing director, Telcon Metals Group), Dr. E. W. Smith (managing director, Telcon Cables Group) and Mr. G. T. W. Whitehead, O.B.E. (director, Johnson & Phillips, Ltd.

Mr. C. H. Blackburn, of E. Dawson (Lamp Factors, Ltd.), has been elected president of the Electrical Wholesalers' Federation for the ensuing year and Mr. H. Riley (John Riley & Son (Electrical), Ltd.) is the new vice-president.

Mr. C. H. Blackburn

Mr. Blackburn, after periods in the Merchant Navy and as a journalist, joined the General Electric Co. in 1922. During the 1939-45 war he served in the R.A.O.C., becoming a lieutenant-colonel. He now commands an Army Emergency Reserve unit (he holds the Emergency Reserve Decoration) and is an A.D.C. to H.M. the Queen.

At a luncheon in London on 22nd March, **Mr. Gabriel Bergman**, chief purchasing officer of the Ministry of Works, entertained sixty of his friends to mark the occasion of his retirement. Mr. Bergman, who has been with the Ministry for forty-four years, retires on 22nd April; he has been a well-known figure at many electrical exhibitions and functions. Mr. Bergman was presented with a console television set on behalf of those present by Mr. F. C. Jarvis.

Mr. M. F. J. Wright has been appointed advertising manager of Black & Decker, Ltd.

A minesweeper, H.M.S. *Thornham*, was launched on 18th March. The vessel was named by **Mrs. H. Pryce-Jones**, wife of Mr. H. Pryce-Jones, manager of the Mid-Sussex District of the South Eastern Electricity Board, who is also chairman of the Shoreham Harbour Board.

Mr. S. A. Clodd, works manager, radio and television, has been appointed an executive director of E. K. Cole, Ltd. He joined the Ekco wartime factory at Aylesbury, Bucks., in 1941 as material controller and transferred to the company's main organisation at Southend in 1945 as production controller, being appointed works manager in 1950.

Mr. S. A. Clodd

Mr. G. H. M. Houston, manager, Power Applications Branch, has joined the board of Brookhirst Switchgear, Ltd.

OBITUARY

Mr. F. R. Baker, works manager of Herman Smith Smithlite, Ltd., died on 17th March at the age of fifty-nine. Mr. Baker had been with the parent company, Herman Smith, Ltd., for over thirty years. During the war years he was manager of the Walsall factory, and returned to Reliance Works, Dudley, in the middle 1940s, when he was put in charge of the lighting division of that company. Upon the formation of Herman Smith Smithlite, who manufacture fluorescent and tungsten lighting fittings, cable trunking, etc., he was made works manager.

Mr. A. Butler.—The death occurred on 22nd March of Mr. Alfred Butler, formerly sales manager of E. Green & Son, Ltd., Wakefield.

Lady Purves, widow of the late Col. Sir Thomas Purves, died on 17th March at her home in the Isle of Wight.

WILLS

Mr. P. V. Hunter, C.B.E., a director of British Insulated Callender's Cables, Ltd., who died on 22nd October last, left £42,502 gross (£33,317 net). He left £100 each to the Benevolent Fund of the Institution of Electrical Engineers and the Electrical Industries Benevolent Association.

Dr. J. H. Partridge, D.Sc., Ph.D., head of the Glass, Refractories and Ceramics Department of the General Electric Co., Ltd., who died on 30th November last, intestate, left £16,335 gross (£16,027 net).

PARLIAMENTARY REPORT

THE Thermal Insulation (Industrial Buildings) Bill, providing for the thermal insulation of all new industrial buildings after 1st January, 1958, and of all existing space heated industrial buildings on a day to be appointed, was given an unopposed second reading without debate in the House of Commons. The Bill, a private member's measure, was introduced by Mr. Gerald Nabarro under the ten-minute rule and now joins the private members' Bills awaiting consideration in House of Commons standing committee.

Under the Parish Councils (Miscellaneous Provisions) Bill, a private member's measure, the numerous long, wordy and obsolete sections of the Lighting and Watching Act, 1833, will be replaced by a modern code which will place responsibility for road lighting squarely upon parish councils. The Bill, which was introduced by Wing Commander Bullus, was recently given an unopposed second reading.

During the debate Mr. Page contended that the responsibility for road lighting should be transferred from parish councils to a larger authority. He regretted that the power of parish councils over the lighting of roads was perpetuated in this Bill. He quoted from a pamphlet issued by the British Electrical Development Association to emphasise the necessity to improve road lighting and thus increase road safety. The night accident rate would be reduced only when there was uniformity in street lighting, at a proper standard, and he hoped that a system could be developed whereby local authorities in an area could group together to achieve this.

Mr. Ronald Bell pointed out that the Bill was concerned not only with the lighting of thoroughfares but also of side roads, where traffic considerations were less important. He got the impression that the Bill would remove the brake on the lighting activities of the parish council.

Mr. J. R. Bevins, Parliamentary Secretary, Ministry of Housing and Local Government, said he would convey the opinions on street lighting to the Minister of Transport and Civil Aviation. He promised Government support for the Bill.

Export Guarantees

The House of Commons gave an unopposed second reading to the Export Guarantees Bill under which export guarantees will be raised from £150 million to £250 million. Mr. Walker-Smith, Minister of State, Board of Trade, moving the second reading of the Bill, said that without an increase in the permitted maximum liability the Department might soon find itself unable to offer further cover.

Mr. Douglas Jay, for the Opposition, supported the Bill, and paid tribute to this E.C.G.D. venture.

He hoped that a result of the Bill would not be that they would be complacent about the present position of British export trade, which had increased only a very few per cent a year over the last five years or so.

Mr. Eric Fletcher said he had heard only two suggestions of a critical nature about the Department. They were both directed to enabling exporters to compete more effectively with foreign exporters. The length of credit which was covered for "Iron Curtain" countries was normally fixed at three months. In special circumstances the Department would give cover for transactions entered into on a six months' credit basis. It was becoming increasingly common on the part of Continental exporters and others to secure in their country extended credit beyond the ordinary 90 days. It was desirable that British exporters should have the same advantage. The Minister should also bear in mind that the limit of 90 days, particularly in the case of "Iron Curtain" countries, was fixed many years ago when the political risk was much greater than it was to-day. He very much hoped that in the near future the Government would be able to announce a very considerable removal, if not total removal, of the existing restrictions on trade with China, because there was a vast potential for British exporters there.

Mr. Walker-Smith, replying to the debate, said it was possible for exports to Russia to be dealt with under the ordinary commercial guarantees. The Government were prepared to encourage trade with East Europe and China in non-strategic goods, but on the question of strategic goods any change in the embargo must be agreed with our partners in the Paris Consultative Group. It was likely that the embargo would be amongst the subjects discussed between the Prime Minister and President Eisenhower at Bermuda.

Price Stabilisation

Mr. Nabarro asked the Chancellor of the Exchequer what discussions were taking place at Ministerial level with the nationalised industries concerned to continue after June, 1957, the price stabilisation policy agreed last year.

Mr. Thorneycroft, Chancellor of the Exchequer, said the boards of the nationalised industries were under statutory obligation to pay their way, taking one year with another. It was for them to decide how this obligation was to be discharged. The Ministers concerned were in consultation with the chairmen of the Boards about their capital expenditure and borrowing requirements in the coming year. He was not in a position to make a further statement.

Cost of Nuclear Power Stations

Mr. Warbey asked the Paymaster General whether he would direct an investigation into the costings on which the contracts for the building of atomic power stations were based, in view of the wide disparity between the cost of approximately £145 per kW installed capacity for the two stations ordered by the Central Electricity Authority and the station ordered by the South of Scotland Electricity Board.

Mr. Maudling declined to do so and said he could not accept the implication contained in the latter part of the question. In their consideration of tenders the electricity authorities could be relied on to carry out any cost investigations required.

Technical Education for Girls

Mr. George Thomson asked the Secretary of State for Scotland what steps he was taking to increase the number of girl students studying for the higher technological qualifications.

Mr. J. S. Maclay said that existing facilities were open equally to boys and girls. They would continue, as occasion afforded, to urge parents, teachers and industry to encourage girls to train and to take up work in the applied sciences.

Restrictive Trade Practices Register

Mr. Derek Walker-Smith, Minister of State, Board of Trade, announced in reply to a question that the register under the Restrictive Trade Practices Act, 1956, would be open to public inspection next month.

Sulphur in Flue Gases

Mr. Hastings asked the Paymaster General how many power stations were situated in the Greater London area, as defined by the Metropolitan Police district, and what percentage of sulphur oxides were being removed from the flue gases of each of these.

Mr. Reginald Maudling, Paymaster General: Forty-nine. Sulphur oxides are removed from the flue gases only at the Battersea and Bankside stations, where the approximate percentages removed in 1956 were 87 and 97 respectively.

Dounreay Scheme Welcomed

Mr. Erroll, Parliamentary Secretary, Board of Trade, stated that by March, 1958, the Atomic Energy Authority

expected the Dounreay project to be employing a total staff of 1,300 and by 1961-62 the total would probably be 2,500. This looked like being a permanent figure and included some 1,600 who would be coming from outside the area. Together with their families, this represented about 5,500 "immigrants." Mr. Erroll was speaking during a debate on the second reading of the North of Scotland Development Corporation Bill, a private member's measure.

Sir David Robertson, who introduced the Bill, described the decision to site the atomic energy plant at Dounreay as the greatest blessing that the Government had given to the Highlands. It was hoped that electronic industries might be attracted to work alongside the plant in the same way as the early industrialists had clustered around the coal mines, the old source of power.

Consultative Councils

Lieut.-Col. Bromley-Davenport asked the Paymaster General whether he would give a general direction to Gas and Electricity Boards to make available further funds in order to make the Consultative Councils better known and more effective.

Mr. Maudling said he had no evidence that the Consultative Councils' efforts to improve their usefulness were being held up by lack of funds.

Scientific and Technological Education

The House of Commons last week discussed scientific and technical education in relation to the recently announced expanded programme of capital investment in the production of power from atomic sources.

Mr. Parkin, who initiated the debate, said that it seemed to some that the expanded programme in atomic power involved a consequential reassessment of the estimated number of scientists and technologists needed, on which previous Ministerial programmes of expansion had been based. The proposals for increasing the numbers of scientists and technologists needed modifying as well as expanding.

Mr. Austen Albu seconded the motion.

Sir Edward Boyle, Parliamentary Secretary, Ministry of Education, replying to the debate, said the effect of the atomic energy programme on the total demands for technical education was already being discussed between the Ministry, the University Grants Committee, and the Atomic Energy Authority. At present, two-thirds of the total force of scientists and engineers was concentrated in industries which accounted for only three-tenths of the total number of employees.

The Government's plan was to increase the number of scientists and technologists produced yearly from the present 10,000 to 20,000 in 10 to 15 years' time. Since the war about 1,000 laboratories had been built in grammar and technical schools at a cost of £4,500,000. About 2,250 laboratories had been provided at modern schools at a cost of £9 million. The value of the equipment provided for these laboratories had been rather more than £2,500,000, divided almost equally between grammar and technical schools and modern schools.

The Minister had asked training organisations and colleges to review the balance of their staffing and recruitment with particular reference to improvement in mathematics and science.

In the current academic year there had been about a 10 per cent increase in the number of training college lecturers teaching mathematics and there had also been some increase in those teaching science.

The universities had worked out, with full Government support, plans for a radical expansion in their science and technology departments. Proposals already made by them provided for increasing the total number of university students from 84,000 in 1955-56 to 106,000 by the mid-1960s. Of this increase about two-thirds would be in science and technology. As part of the programme of expansion the University Grants Committee was giving authority for the start of new building costing £10,500,000 for 1957; £12 million for 1958; and £12 million for 1959.

The growth of technical colleges had been rather haphazard and the time had come to improve the organisation for technical education. The colleges were being classified in four categories and local authorities were being encouraged to work together in groups to cut down duplication of courses and make more efficient use of staff and buildings.

The Ministry were authorising a programme of new buildings and equipment costing £85 million to be put in hand by 1960-61. Over one-half had been authorised for particular projects.

A special sub-committee of the Ministry was studying the training and recruitment of teachers and was expected to report soon. Plans were in hand for big increases in full time and sandwich courses. It was hoped to double the number of students from 4,000 to 8,000 or 9,000, and it was hoped that by the late 1960s technical colleges would be producing at least 5,000 technologists a year.

The motion was agreed to.

Lords Debate on Nuclear Programme

A motion by Lord Hall calling attention to the expanded nuclear power programme, which was to have been debated in the House of Lords last week, has been postponed until 2nd April because of the time taken up by a debate on a motion to annul the Traffic Signs Regulations.

Engineering Strike

Following the closing down of the shipyards, unions affiliated to the Confederation of Shipbuilding and Engineering Unions began to call out members employed in the engineering industries. As a result some 600,000 in ten areas struck work this week and the unions threaten to withdraw the remainder of their members by the end of next week if no settlement is reached.

Talks between the Minister of Labour and representatives of the shipbuilding employers and workers on Monday last proved to be abortive and the Minister announced his intention of setting up a court of inquiry. It was reported that the shipbuilding employers had offered to increase wages by 5 per cent upon certain conditions but this was not acceptable to the unions.

As the position in the engineering industries appears to hinge upon the course of events in shipbuilding, at the time of our going to press there was no sign of a return to work. The areas affected are Manchester, Merseyside, Tyneside, Wear, Tees and Hartlepools, Sheffield, Bristol, Southampton, Clydeside and Belfast, and a number of electrical concerns are involved.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £238 10s 0d
Fire Refined 99·70%	ton £237 0s 0d
Fire Refined 99·50%	ton £236 0s 0d
COPPER Tubes ..	lb 2s 3½d
Sheet	ton —
H.C. wire and strip ..	ton £285 5s 0d
LEAD, English ..	ton £113 5s 0d
Foreign	ton £112 0s 0d
MERCURY	flask £85 10s 0d
TIN, block (English) ..	ton £795 0s 0d
ZINC, G.O.B. Foreign	ton £96 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 11½d
Sheet	ton —
Wire	lb 2s 7½d
PHOSPHOR BRONZE Wire	lb 3s 11½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 27⅛d—27⅜d

Vacuum Cleaners

In our survey of domestic electrical equipment dealing with vacuum cleaners (22nd March issue), the prices of the General Electric Co.'s cleaners were incorrectly given. Both models, DM.310A (cylinder) and DM.380 (upright), have been increased by £1 1s and are now priced at £16 16s each, plus £7 7s 6d purchase tax. The price of the accessories for the upright model remains unaltered at £3, plus 13s 2d purchase tax.

A.C. Installations in Ships

THE object of a paper on "Developments in Marine Electrical Installations with Particular Reference to A.C. Supply," which was read by Mr. A. N. Savage before the Institute of Marine Engineers on 26th March, was to give a clearer understanding of the technical, operational and economic problems which had arisen as a result of the increasing size and capacity of the equipment employed. While the demand for power had risen no attempt had been made to economise in valuable raw material or to reduce the weight per kilowatt or space occupied by the plant. Class A insulation was still generally used for the machines, although far more economical alternators were available. Motors were still designed on a full load plus sustained overload basis and control gear had become more elaborate, the result being larger, heavier, more costly and more troublesome installations.

Suitable as d.c. undoubtedly was for the earlier ship-board installations, where the load was mainly lighting, it had the disadvantages that there was no effective method of locating faults and that fuses and circuit-breakers on a 220 V system must be designed to cope with far greater short-circuit currents than would be experienced on a 440 V asymmetrical a.c. installation. The total instantaneous short-circuit current on a 220 V d.c. system with a generator capacity of 2,400 kW was 109,800 A, while fuses would not operate efficiently at currents exceeding 33,000 A. To employ fuses would therefore be potentially dangerous. To reduce these large prospective short-circuit currents the first step must be to adopt higher operating voltages and a three-phase a.c. system. This meant that if the installation was not properly designed it could result in the loss of the vessel. In particular, further research must be carried out into the magnitude of prospective short-circuit currents and all types of circuit-breakers should be tested by an appropriate authority.

Plant Characteristics

Alternators and induction motors were simpler, safer, more reliable and more economical (both in first cost and maintenance) than d.c. generators and motors. They lent themselves more readily to the employment of modern insulating materials which were suited to high temperatures thus permitting further reductions in weight and bulk. Induction motors, particularly those with squirrel-cage motors, were much less susceptible to the effects of moisture and dirt than d.c. machines, consequently they could be of the ventilated type for practically every application aboard ship. The direct-on started squirrel-cage motor could be utilised for all services. In addition to its outstanding advantages of simplicity and reliability it was compact, the combination of motor and control gear requiring less space than with any other type of machine. The extreme simplicity of the control gear also permitted remote control from a central point to be used.

Critics of a.c. installations never seemed to tire of raising the bogies of increased generator capacity as compared with d.c. and the risk of total black-outs and voltage dips due to the starting currents of large squirrel-cage motors. It was also argued that the first cost of a.c. would not be less than that of d.c. and that the saving in maintenance had yet to be proved. Such points did not arise in a correctly designed installation, but far too many of those connected with ship-owning were prone to adopt the attitude of "better the devil you know than the devil you don't know."

Ideal System

The ideal system of distributing a.c. on board ship was three-phase three-wire. With this all motors of 0·25 h.p. output and upwards, as well as galley ovens and boiling plates, could be connected to the 440 V busbars. Heating and single-phase power could be supplied through 440/250 V transformers and lighting circuits through 440/230 V transformers with the mid-point of their secondaries earthed or alternatively through 440/1,500 V transformers. With this system a dead earth could occur on an essential circuit, such as the steering gear, without affecting satisfactory operation. An advantage of employing a number of transformers was that the installation was divided into sections each of which was electrically isolated from the other. An earth fault on one section could therefore not combine with a fault on another to constitute a fire hazard and the short-circuit capacity of the 230 V section was reduced, owing to the transformer reactance.

Plant Requirements

On board ship the alternators would normally be of the rotating salient pole type and to obtain the maximum reliability should have comparatively low voltage (say, 100 V) excitation. They should be of the dust-ventilated type with filters in the inlet ducts. They should be designed for continuous maximum rating and Class B insulation, a combination which resulted in a cheaper and lighter machine that occupied less space. In order to maintain reasonable values of power factor and efficiency care should be taken not to install over-sized motors. Except in special cases they should be of the ventilated or deluge-proof type with Class B insulation. They could all be of the squirrel-cage pattern. Direct-on starting could be employed throughout.

Certain items in an a.c. installation would be more expensive in first cost than d.c.; others would be considerably less. But the larger the installation and the greater the number of motors the greater would be the saving. The cost would depend on the compilation of a detailed and water-tight specification which would be prepared after various manufacturers' equipment had been demonstrated and the type considered most suitable for the purpose had been selected. As regards maintenance the cost of an a.c. system would be considerably less and, if properly planned and installed, safety and reliability would be higher.

In dealing with lighting, the author pointed out that approximately three times the power was required for metal filament as compared with fluorescent lighting for the same intensity of illumination. It followed therefore that the fuel consumption would be three times as great and in an air-conditioned ship the fuel consumption for air conditioning relative to the lighting load would be in the same proportion.

Metal Prices Since 1899

Oliver Brothers, Inc., 421, Canal Street, New York, 13, have sent us a copy of a chart which they have prepared showing the course of metal prices in the United States from 1899 to 1956. It includes several kinds of iron and steel products, copper, lead, zinc and tin.

E.W.F. ANNUAL DINNER

Professor D. R. Seaborne Davies *Mr. C. H. Blackburn* *Mr. J. G. Christopher*

President on Effect of Restrictive Practices Act

MR. T. D. WOODS, the president, was in the chair at the annual dinner of the Electrical Wholesalers' Federation at the Dorchester Hotel, London, on 21st March, when many well-known electrical people were present.

The principal guest was Professor D. R. Seaborne Davies, M.A., LL.B., Professor of Common Law in the University of Liverpool, who proposed the toast of the Federation. In doing so he made particular mention of eminent people associated with Liverpool, including the president himself and Lord Citrine and Sir Josiah Eccles who were present at the dinner.

Professor Davies said that many people in this country in their political and economic theories overlooked the hazards of mercantile venture. The wholesaler was not an unnecessary link in the country's mercantile affairs and members of the Federation had discharged a most useful function for the past forty-three years.

In the course of his acknowledgment of the toast Mr. Woods referred to the Restrictive Trade Practices Act which, he said, was introduced in the belief that it would give more freedom in trading. But it had truly been said "Oh Liberty! how many crimes are committed in thy name!" and the Act might well prove to be another.

Before the passing of the Act the industry had reached a state through trial and error, depression and boom and, in many cases, costly experience, adapting itself so as to give capital and labour a fair return for their efforts, removing the fear of unemployment and ensuring a fair and equitable price level. Now, apparently, this was all wrong and freedom at any price was the call. Trading associations which had attained this end must now cease and there must be competition, or even "jungle warfare."

Recalling the difficult conditions created by "freedom" after the 1914-18 war, Mr. Woods asked if we were to witness these things all over again. It might well be that bigger monopolies than ever before would be created by the absorption of the weaker by the stronger in the struggle for existence. Crowding into this scene was also the European Common Market by which we were to throw over Commonwealth trading and allow competition from Europe which might have serious results.

The president said that wholesalers had often been attacked by the misinformed and they should tell the business world that they were a live force and an indispensable link in the chain of distribution. By holding stocks they enabled the manufacturer to budget ahead; they also extended credit facilities to the retailer or user and acted as purchase tax collectors.

Despite their difficulties they, as a Federation, were determined to adapt themselves to current business requirements, believing that they had a function to perform in the industry for the benefit of all.

Mr. Woods paid a tribute to the work of the director and secretary (Mr. A. B. Wildsmith) who, he said, was shortly to retire when he would be succeeded by Mr. C. H. Etherington.

Mr. A. B. Wildsmith (director), Lord Citrine and the president (Mr. T. D. Woods)

Purposes of the E.L.I.C.

The health of the guests was proposed by Mr. C. H. Blackburn, vice-president, and responded to by Mr. J. G. Christopher, chairman of the Electric Lamp Industry Council. Mr. Christopher said that when it was decided to wind up the Electric Lamp Manufacturers' Association, the lamp makers felt that they had to retain a common platform and so the E.L.I.C. was formed. Its purposes were to deal with standardisation, encourage better lighting and conduct negotiations with other bodies.

They had no intention of trying to control list prices but proposals relating to discounts, quantity buying, etc., were to be introduced on 1st July.

The sale of lamps at lower prices than before the war had only been achieved by improved manufacturing efficiency. In the face of the proposed European Economic Union the lamp industry must be prepared to produce at prices which could compete with those of Continental manufacturers and he asked the wholesalers for their assistance in achieving this through the Electric Lamp Industry Council.

OVERSEAS ELECTRICAL TRADE

Rise in Electrical Exports in February

AFTER an indifferent beginning to the year, United Kingdom electrical exports staged a sharp recovery in February, and despite the fact that there were fewer working days than in January, the total value was £19,320,808, as compared with £16,989,763 for the preceding month. The total was also £2·3 million better than for February, 1956. Practically all categories of electrical goods shared in the improvement, but the most spectacular advance was in the converting machinery, rectifiers, transformers, etc., group which showed an increase of nearly £900,000 on January's figure. The other principal increases were in generating sets, generators, and motors, which rose from £2,432,972 in January to £2,742,486 last month, radio equipment, from £2,665,209 to £2,967,037, and cables and wires, from £2,665,811 to £2,950,605. There was a slight fall in exports of telegraph and telephone equipment, from £1,845,751 to £1,736,369.

India was once again the best market for generators and motors, taking plant valued at £353,510. Second place was held by South Africa with purchases of £248,880, and Australia was third with £190,820. India

TABLE I.—ELECTRICAL EXPORTS

Class	February, 1957	Two months ended February, 1956	Two months ended February, 1957
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	117,896	216,213	262,743
Ditto, 10 to 65 kW	126,329	208,840	266,819
Ditto, 65 to 200 kW	86,097	279,578	161,929
Ditto, over 200 kW	433,453	715,326	675,832
Spark ignition engine driven	10,956	87,741	20,750
Steam turbine driven	20,390	33,318	45,208
Hydraulic turbine driven	—	51,786	—
Other prime mover driven	16,235	82,240	27,851
Generators, not exceeding 200 kW	100,082	317,527	310,766
Ditto, over 200 kW	134,845	149,428	176,224
Parts of generators	329,887	1,351,517	633,224
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ¼ h.p.	183,339	406,352	365,104
Over ¼ but under 1 h.p.	60,594	125,777	102,019
1 h.p. to 250 h.p.	547,714	896,728	1,003,227
Over 250 h.p.	88,992	101,645	249,174
Railway, tramway and trolley-bus motors complete and parts of all motors	157,943	375,355	311,740
Motor starting and controlling gear	327,734	475,263	569,501
	2,742,486	5,874,634	5,182,111
Converting machinery	26,523	68,715	167,029
Mercury-arc rectifiers	25,066	156,796	56,950
Transformers for lighting, heating and power (incl. coils):			
Not exceeding 7,500 kVA	700,713	2,029,070	1,076,027
Over 7,500 kVA	256,580		442,183
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660 V	338,788	437,933	616,787
Ditto, other	1,445,793	2,437,888	2,344,440
	2,793,463	5,130,402	4,703,416
Primary batteries:			
Lighting	92,768	175,028	192,556
Radio	287,682	433,845	592,421
Other	56,085	87,309	92,418
Parts (excl. carbons)	50,544	80,879	98,266
Lamps:			
Filament, exceeding 28 V*	89,300	196,035	163,593
Ditto, under 28 V*	42,263	62,855	74,071
Arc lamps and searchlights	11,222	32,385	22,490
Discharge lamps, fluorescent tubes, etc.	113,132	151,018	207,382
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilising and cold cathode valves, magnetrons, klystrons	28,315	55,902	50,226
All other	310,799	403,294	552,433
Parts (excluding glass bulbs)	10,356	36,315	18,225
Radio and television transmitters	101,240	136,772	194,341
Commercial radio and radar equipment	1,260,089	2,265,555	2,361,713
Domestic radio receivers, mains	99,112	336,903	196,832
Ditto, battery	54,494	168,442	101,398
Ditto, other (incl. car)	20,818	56,003	47,154
Radiograms	23,530	79,841	49,190
Television sets	41,269	109,717	112,027
Public address equipment	94,353	179,078	196,332
Other radio and television apparatus, n.e.s.	62,231	84,744	126,657
Components and parts, n.e.s.	860,431	1,266,891	1,629,994
	2,967,037	5,179,457	5,636,522
Telegraph and telephone installations	594,452	1,398,228	1,412,511
Telephone instruments, separately consigned	164,497	218,378	304,673
Telegraph and telephone parts	911,294	1,169,495	1,668,254
Line apparatus for long distance commun.	66,126	184,094	196,682
	1,736,369	2,970,195	3,582,120

Class	February, 1957	Two months ended February, 1956	Two months ended February, 1957
	£	£	£
Cookers	75,363	180,148	132,533
Toasters	10,564	43,585	25,475
Other cooking apparatus	36,131	72,928	62,262
Parts and accessories	71,907	158,058	144,018
Space heating appliances	39,266	111,275	77,804
Water heating appliances	30,840	60,076	53,773
Other heating appliances	43,703	59,081	75,096
Parts and accessories	72,505	132,789	132,747
Irons	53,278	217,417	114,498
Arc welding equipment, a.c.	71,312	95,326	123,127
Ditto, d.c.	58,156	72,973	106,941
Resistance welding equipment	18,537	45,793	34,840
Electric furnace plant	85,849	111,875	194,835
Magnetos, ignition	37,163	67,245	74,844
Sparking plugs	165,129	305,852	340,240
Elec. appliances for aeroplanes, n.e.s.	269,985	361,911	500,627
Ditto, for motor vehicles, n.e.s.	398,517	659,693	717,693
Ditto, for cycles, n.e.s.	54,711	156,709	93,456
Signalling app. (incl. traffic signals)	98,517	101,586	183,269
Instruments, commercial	202,742	339,761	365,168
House service meters (including parts)	210,104	373,564	357,787
Electro-medical apparatus (not X-ray)	29,756	94,589	58,937
X-ray apparatus (excl. tubes and valves)	65,465	119,444	125,444
Vacuum tubes	75,308	45,691	104,427
Ceiling fans, complete	115,508	196,100	213,660
Desk fans, complete and parts of desk and ceiling fans	46,198	45,841	69,881
Vacuum cleaners	161,489	275,868	316,398
Floor polishers	62,301	172,225	146,992
Food mixers	46,365	127,766	101,138
Hair clippers and dry shavers	69,425	199,003	202,563
Other portable appliances	26,824	58,810	56,388
Parts	115,275	195,368	247,577
Portable elec. tools (not saws) and parts	252,440	366,536	459,897
Cables and wires:			
Telegraph and telephone, submarine	8,314	77,085	98,072
Ditto, other	866,935	1,557,306	1,895,999
Cotton, silk or art. silk insulated	50,211	107,127	81,320
Enamel, glass or asbestos insulated	112,684	167,708	195,911
Paper insulated	892,709	2,351,590	1,405,573
Rubber insulated	645,727	1,035,042	1,259,990
Thermoplastic insulated	158,605	264,590	299,774
Other	215,420	512,952	380,166
	2,950,605	6,073,400	5,616,805
Accumulators for motor vehicles	172,715	383,406	292,698
Ditto, traction	30,390	44,338	62,868
Ditto, radio and other portable	102,123	182,774	166,067
Ditto, other	22,354	132,408	54,108
Parts and accessories	101,282	192,796	211,824
Elec. porcelain, etc. (incl. insulators), n.e.s.	116,467	195,754	219,108
Insulating cloth and tape	59,645	140,205	132,309
Other insulating material	91,504	186,810	192,406
Permanent magnets	47,749	75,701	88,058
Radio, telegraph and telephone testing equipment, n.e.s.	82,394	59,528	121,041
Scientific elec. instruments (not telegraphic or telephonic):			
Time recorders and time switches, complete	7,116	24,431	18,753
Other	312,143	405,645	651,471
Electrical machinery, n.e.s.	77,176	259,342	135,481
Electrical apparatus and appliances, n.e.s.	994,161	1,552,355	1,810,101
TOTAL	19,320,808	35,907,821	36,334,799

* The figures for 1957 are not completely comparable with those for previous years

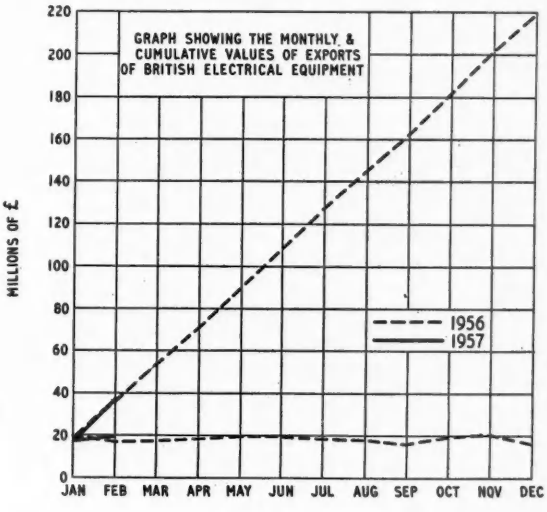
TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	February, 1957	Two months ended February, 1956	Two months ended February, 1957
	£	£	£
Channel Islands	126,697	161,027	222,173
Gibraltar	8,263	28,339	19,141
Malta and Gozo	43,093	174,339	77,097
Cyprus	130,781	235,045	259,243
Sierra Leone	23,019	46,403	61,744
Gold Coast	158,511	287,942	346,392
Nigeria	261,526	651,030	593,721
Union of South Africa	1,473,842	2,826,340	2,890,147
Rhodesia and Nyasaland	502,171	1,194,946	1,007,618
Tanganyika	79,186	121,153	118,115
Kenya	415,771	446,506	540,635
Uganda	142,220	153,471	205,011
Mauritius	64,778	51,539	86,144
Aden	75,623	123,335	106,326
Bahrain, Qatar and Trucial States	369,505	181,306	375,273
Kuwait	438,360	189,670	509,971
India	2,438,624	3,853,380	4,207,700
Pakistan	327,971	618,351	469,551
Singapore	303,471	568,371	668,534
Federation of Malaya	326,715	499,688	684,134
Ceylon	173,778	292,057	343,893
British North Borneo	38,544	99,200	48,171
Sarawak	6,727	56,083	38,410
Hong Kong	193,537	346,805	486,151
Australia	1,744,225	3,614,359	3,227,829
New Zealand	923,009	2,017,928	1,962,747
Fiji	18,647	30,182	38,308
Canada	873,947	1,445,924	1,798,001
Jamaica	99,295	214,284	158,037
Barbados	21,111	63,458	44,099
Trinidad	134,699	229,443	230,419
British Guiana	34,957	93,825	81,384
Other Commonwealth countries	75,839	143,942	186,990
Irish Republic	211,848	610,905	429,938
Soviet Union	226,941	596,288	372,228
Finland	101,097	257,615	215,184
Sweden	384,012	545,852	697,286
Norway	210,427	359,707	432,812
Iceland	7,866	36,612	13,563
Denmark	245,046	287,615	375,825
Poland	54,730	49,887	86,249
Western Germany	212,959	353,762	464,950
Netherlands	712,987	1,108,389	1,379,121
Belgium	336,222	555,906	667,348
France	489,435	619,389	895,260
Switzerland	108,827	192,378	237,739
Portugal	231,132	334,821	430,330
Spain	358,819	379,046	738,340
Italy	221,665	581,336	512,106
Austria	25,427	125,872	46,077
Yugoslavia	59,342	194,720	86,239
Greece	117,142	244,407	195,719
Turkey	113,072	123,155	124,974
Belgian Congo	45,357	63,540	88,778
Portuguese East Africa	26,001	46,859	51,178
Egypt	42	335,878	593
Libya	32,352	22,150	48,959
Southern Morocco	64,973	95,869	124,488
Sudan	129,023	101,440	277,381
Syria	19,972	83,889	68,037
Lebanon	22,933	67,051	60,715
Israel	98,986	124,533	163,689
Jordan	30,770	139,403	92,927
Saudi Arabia	26,557	131,295	67,099
Iraq	176,923	725,546	450,293
Iran	151,201	441,782	385,172
Burma	77,874	296,594	124,318
Thailand	93,017	226,178	166,228
Indonesia	16,142	105,765	118,722
Japan	56,045	96,822	110,979
United States	644,701	1,719,096	1,336,495
Cuba	22,709	82,362	60,824
Mexico	57,205	116,050	114,239
Colombia	40,904	267,298	84,100
Venezuela	243,931	796,096	591,887
Peru	27,541	105,121	97,618
Chile	49,485	44,200	88,669
Brazil	121,109	412,475	158,117
Uruguay	19,956	17,619	40,502
Argentine Republic	82,401	94,471	153,838
Other foreign countries	465,260	531,106	714,557
TOTAL	19,320,808	35,907,821	36,334,799

was also largely responsible for the rise in exports of converting machinery, etc., the value being £736,772. The next two countries in order of importance were Australia, which imported plant valued at £319,141, and South Africa, with imports of £315,042.

Australia continued to hold first place as the most important market for radio equipment, her purchases totalling £286,759. Outside the Commonwealth, France took equipment valued at £181,305, and the Netherlands' share was £180,563. In the telegraph and telephone apparatus group, Australia took the lead with imports valued at £281,386, New Zealand dropping to second place with a total of £191,682, and South Africa coming third with £191,124.

India was by far the best customer for electric cables and wires with purchases of £628,952. The United States took supplies valued at £310,905 and New Zealand bought cable valued at £236,609.



The various categories of electrical exports are detailed in Table I, while their distribution is shown in Table II.

Electrical equipment shown elsewhere in the Board of Trade returns includes the following:—

Electrically operated washing machines, complete, not exceeding 150 lb net weight: February, £266,467; two months, £650,924. Ditto, 150-250 lb net weight: February, £107,496; two months, £206,930. Parts: February, £76,253; two months, £128,790.

Electric carbons, including parts: February, £49,625; two months, £111,628.

Welding electrodes (excluding carbon), covered: February, £136,307; two months, £241,985.

Electric conduit tubes and cased tubes: February, £99,732; two months, £176,845.

Electric locomotives: February, £261,565; two months, £639,997. I.c. locomotives with electrical transmission: February, £141,500; two months, £324,487.

Electrical Imports

There was a fall in imports of electrical machinery and apparatus in February, as compared with January, from £2,255,456 to £1,973,027, but the total for the first two months of this year of £4,229,436 exceeded that for the corresponding period of 1956 (£4,060,280) by nearly £200,000. The three leading suppliers were the United States, Germany and the Netherlands which shipped goods valued at £662,356, £363,427 and £260,302 respectively.

Technical Book Catalogue

A catalogue of technical books published by Iliffe & Sons, Ltd., is now available. Architecture, automobiles, aviation, electrical engineering, radio and television, and welding are among the many subjects covered. The catalogue is obtainable free from Dorset House, Stamford Street, London, S.E.1.

Power Station Chimney Emissions

Effect of Dust and Sulphur Dioxide

FOUR papers by members of the staff of the Central Electricity Authority concerning possible contributions to atmospheric pollution by modern power stations were presented before the Institute of Fuel on 27th March. The general position was discussed by Messrs. W. D. Jarvis and L. G. Austin in a description of monthly routine surveys of the effect of dust and sulphur dioxide around station sites, where upwards of 2,000 tons were in some instances consumed daily.

Previous theoretical calculations of the maximum pollution at ground level the authors regarded as providing inadequate information as to the effectiveness of precautions taken in the design of new stations including higher chimneys and efficient grit arrestors. Measurements were made of pollution at 28 stations, when possible up to two years before commissioning; in most cases, however, records for five months only were obtainable. Comparisons with post-commissioning results for the 19 of those stations that were in operation between 1st October, 1955, and 30th September, 1956, showed that the rate of dust deposition in the neighbourhood bore no relationship to the amount of coal consumed and that the increases in average values within a radius of two miles were less than the casual errors observed in deposit gauge results.

The amount of sulphur dioxide emitted was masked by many variables, particularly changes in concentrations due to other causes during the period of the surveys and by considerable differences between winter and summer. The maximum contribution by power stations was believed to be less than 0·2 mg SO_3/100 sq cm/day. The ability of lead-peroxide instruments to detect changes of this amount was doubted and other methods of measurement, using short-period determinations, were expected to provide more reliable information.

An intensive survey of dust deposition near Little Barford power station formed the subject of a paper by Messrs. G. England, C. J. Crawshaw and H. J. Fortune. This 120 MW fifteen-year-old station was chosen because of its situation in flat country remote from other sources of industrial pollution. Its four 300 k lb/hr p.f. boilers were served by two chimneys 275ft high instead of the 400 to 500ft now being provided. The precipitations were small by modern standards and the total emission of dust would be comparable with that of much larger modern stations fitted with the more efficient grit-arresting equipment now under construction.

Seventeen deposit gauges (B.S. 1747) were distributed within 2¼ miles of the station and the insoluble deposit trapped by them contained 50 to 70 per cent of ash. The bulk of the dust emitted did not fall within 2¾ miles of the power station and further afield its effects were hardly detectable. Measurements close to the station were comparable with normal rates in a rural area. The greater proportion of the deposits came from extraneous sources and often contained appreciable amounts of soil.

These conclusions were confirmed by Mr. D. H. Lucas whose experimental work showed that a deposit gauge at ground level collected far more dust than when 4ft above. Much of this additional dust was spurious deposition re-entrained from the ground. The standard gauge caught twice as much dust on an average when its bowl was kept wet. The amount found at any place depended not only on the deposition rate there but also on the power of the gauge to retain dust at wind velocities above 20 ft/sec; the average retaining power appeared to be about 50 per cent. At Little Barford about one-quarter of the dust collected came from the power station, only a small proportion falling within two miles of it.

Variations in the rate of emission of sulphur dioxide and in the meteorological conditions could cause rapid changes in its concentration in the atmosphere at any point, so that continuous records of short-peak values were required as well as average values. For this purpose lead-peroxide candles and volumetric sulphur dioxide estimations were inadequate. An automatic recorder and a portable meter which had been developed for measuring small quantities of the gas, were described by Messrs. W. G. Cummings and M. W. Redfearn. The principle employed in the recorder was the absorption of the sulphur dioxide in the air by a hydrogen peroxide reagent in a continuous counter-current column. This resulted in the formation of sulphuric acid in the reagent solution, the increase in the conductivity of which was measured.

The recorder had a range of 0 to 50 p.p.h.m. with a sensitivity of 1 p.p.h.m. (one part of sulphur dioxide per 100 million parts of air by volume), but its range could be extended, subject to proportionate decrease in sensitivity. A mains supply was required, but for short periods of operation a small motor generator could be used. The mobile non-recording portable meter, which was battery operated for use in a small car, had a similar range and sensitivity and was designed for rapid measurements at various points in a selected area. Its functioning was based on the reaction of sulphur dioxide in the air with a starch-iodine reagent in a counter-current absorption column. The amounts of light absorbed by the unchanged and the partly decolourised reagent were compared by photo-electric cells connected to a galvanometer. Investigations with these instruments were showing that when the plumes from modern power stations reached the ground the concentrations of sulphur dioxide in them were low.

Nyasaland Power Demand

THE demand for power in Southern Nyasaland is expected to treble in the next nine years, from 3,700 kW to 10,500 kW, according to a recent survey made at the request of the Federal Government. The Blantyre-Limbe power station could meet this demand up to 1962 by the installation of one additional 2,500 kW unit, if power from the Shire hydro-electric project was available in that year, states the *Overseas Review* published by Barclays Bank.

The first project to be started in the Shire Valley scheme is envisaged as the permanent barrage at Matope with a limited power installation and some preliminary reclamation work in the Elephant Marshes in the Shire Valley, states the *Review*.

A new Federal statutory body, the Nyasaland Electricity Supply Commission, established on 1st February, took over the work formerly carried out by the Nyasaland Department of Electrical Services. An Electricity Council has also been set up to advise the Minister of Power on matters relevant to the generation and supply of electricity.

New Bulk Supply Tariff

Changes in Proportions : Complicated Fuel-Cost Variation

By D. J. BOLTON, M.Sc., M.I.E.E.

THE Central Electricity Authority has given particulars of the tariff governing the supply of electricity to the Area Boards in England and Wales for the year ending 31st March, 1958. In addition to the changes (both up and down) in the magnitude of the charges, designed to reflect the varying pattern of generation costs, there are some changes in the tariff framework. Although nominally these changes only affect certain definitions and methods of measurement they are likely to make a material difference to the relative contributions of the different Area Boards.

After defining the points of supply in the same terms as in previous years the tariff document sets out the two charges making up the total price. The maximum demand is defined in the same way as before but the standing charge which is based on it now consists of two half-yearly portions designed to facilitate the forthcoming change of " ownership."

The running charge also has not escaped the attentions of the tariff reformers. Although the charge itself has changed only in magnitude, and that slightly, the fuel-cost variation has changed out of all recognition. The mathematicians have fairly been given their heads, and the result is a perfect maze of formulæ and fantastication. Whilst the Area Boards are busy working out the odds and trying to see whether they individually stand to win or lose the Central Authority, having devised the formula, is presumably in the position of the " bookie " who is all right whatever happens.

Change in Tariff Prices

The changes in the magnitude of the charges can be summed up by saying that the standing charge is up by 15 per cent whilst the running charge is down by 6 per cent. Since about 30 per cent of the bulk supply revenue is by way of the standing charge and 70 per cent by way of running charge the overall effect is that of an increase of 0·3 per cent in the average price. Such a change in overall magnitude certainly cannot be regarded as excessive. The effect on any particular Area Board will, of course, depend on its load factor. High-load-factor Boards will benefit from the change in the proportions whilst those with load factors below the average will be worse off.

This change in the proportions of the two charges represents a normal trend in electricity supply economics. Unless the price of fuel per thermal unit increases faster than the price of plant per kilowatt (i.e. if both remain constant—a beautiful thought!—or if both rise in the same ratio) it must be expected that the standing charge will rise and the running charge fall or at least not rise so much. More expensive and more efficient generating plant is continually being installed, resulting in greater investment per kilowatt and less fuel per kilowatt-hour.

Standing Charge

There is a change in the format as well as in the magnitude of the kilowatt charge. Instead of a single figure for the year of £5/kW of simultaneous m.d. the charge is at the rate of £5 10s per annum in respect of the first six months of the year and at the rate of £6 per annum for the remainder of the year. Presumably this is in order to meet the situation which will arise if the generation activities are handed over to a new authority on 31st December when only three-quarters of the tariff period will have run out. The two rates will apply to the same assessment of m.d. and will effectively, if not legally, amount to exactly the same thing as a single charge of £5 15s/kW for the year.

As in other recent years there is a stated expectation figure for the aggregate demand which is 19,500 MW for the coming year as compared with 18,000 MW for 1956-57—an increase of 8½ per cent. If the maximum demands of all the Area Boards and other direct consumers in England and Wales exceeds or falls short of this by more than 1 per cent the charges are all scaled down or up accordingly. The purpose of this provision is that if, for example, owing to a severe winter all the demands increase more than normally the charges are reduced to their equivalent for a normal year.

There is no change in the assessment periods which continue to be limited to the week-day working hours—7 a.m. to 7 p.m. on Mondays to Fridays and 7 a.m. to 12 noon on Saturdays.

It will be noted that the archaic terminology of the 1926 Act is still followed in speaking of the " fixed kilowatt charge "—a term which accords neither with normal usage nor with the B.S.I. Glossary; nor, be it added, with plain common sense, for how can a charge which varies with the kilowatts be described as " fixed "? There are also all those noughts which result from the refusal to use megawatts instead of kilowatts, which seems to treat the Area Boards as having less technical sense than the average radio listener who takes " megacycles " in his stride.

Running Charge

The basic running charge is to be 0·47d/kWh instead of 0·5d, a drop of 6 per cent. The basic fuel price is 60s for fuel of calorific value 11,000 B.Th.U./lb and the rate of variation is, as before, 0·0006d/kWh for each penny in the fuel cost per ton. So far so good: a small change in magnitude but apparently no change in the general structure. But it is when he comes to the definition of " fuel cost per ton " that the Area Board officer takes a deep breath and sends for his digital computer. For this definition takes up nearly two-thirds of the whole tariff document, and is certainly a masterpiece of complication.

The first point to note is that there are two alternative calculations (*a*) and (*b*) for the fuel cost per ton. Both are worked out and whichever is the lower is used to vary the basic running charge. Alternative (*b*) is described as the " area fuel cost per ton " and is exactly the same as has been used in the past. It is found by taking the total cost of the fuel consumed in the Authority's stations in the Board's area, dividing it by the total number of tons so consumed, and adjusting it for the average gross thermal value above or below 11,000 B.Th.U./lb.

Alternative (*a*) is the weighted average of the area fuel cost per ton for the energy generated in that area and

the residual fuel cost per ton for the energy imported. The calculation of the residual fuel cost per ton is even more complicated. It is necessary first to find the amount by which the national fuel cost per ton multiplied by the kWh supplied in the area of each Board exceeds the sum of every Board's area fuel cost multiplied by the kWh generated in its area. This is then divided by the aggregate of all the imported kWh, and the sum of 6s is added thereto. It only remains to define the national fuel cost per ton which has the same meaning as the area fuel cost per ton but applied to the whole of the Authority's area.

The operation seems to call for a mathematical formula, and in the following expression the initials "F.C." stand for "fuel cost per ton."

Running charge = 0·47d/kWh ± 0·0006d/kWh for each 1d per ton above or below 60s in the F.C.

The F.C. is the lower of the two quantities (*a*) and (*b*).

Quantity (*b*) is the area F.C. as defined above.

Quantity (*a*) =

$$\frac{\text{Area F.C.} \times \text{kWh generated in area} + \text{Residual F.C.} \times \text{kWh imported}}{\text{kWh supplied}}$$

$$\text{Residual F.C.} = 6\text{s} + \frac{\text{National F.C.} \times \text{kWh supplied in areas} - \Sigma\ \text{Area F.C.} \times \text{kWh generated in area}}{\text{Aggregate of kWh imported into all areas}}$$

National F.C. is defined above. The 6s is presumably an allowance for transmission costs.

It all seems perfectly logical, though a trifle unconvincing. At least it represents a heroic attempt to meet the mounting criticisms of the regional fuel cost adjustment in its present form.

In the early days of the Authority's operations the electricity supplied to any given Board was almost all generated in that area. The running charge was varied in accordance with the mean price of the fuel consumed in the area, and two reasons were given for making this variation. The first reason was the obvious one of relating the bulk supply charge as closely as possible to the cost of generation. The second reason was to enable the Area Boards to compete on level terms with industrialists who would otherwise (in cheap coal areas) have an undue incentive in the direction of private generation.

The second of these reasons is as valid as it ever was but the first is losing some of its force. Already Area Boards in dear coal areas are objecting to a fuel-cost increment being applied to the whole of their supplies when some of these supplies are actually imported from cheaper-coal areas. Moreover, the process is likely to extend, and with the advent of the supergrid and of remotely-sited atomic stations it must be expected that increasing quantities of electricity will be generated outside the areas in which they are used.

Two other factors would appear to sound the death knell of the regional fuel-cost variation, at least on an Area basis. One is that under the new legislation there will be much less reason for the generating divisions each to be exact counterparts of the corresponding Boards' areas, and a rearrangement on a more technical basis may occur. The second reason is that quite a different sort of adjustment would be needed to deal with atomic-fuelled stations.

British Refrigeration Association

SPEECHES AT ANNUAL LUNCHEON

OVER 400 members and guests were present at the annual luncheon of the British Refrigeration Association last Friday at the Connaught Rooms, London, W.C.2. The chairman of the Council, Mr. D. S. Carruthers, presided and the principal guest and proposer of the single toast (apart from the Loyal Toast), that of the Association, was Sir Eric Harrison, K.C.V.O., High Commissioner for Australia.

Among the points mentioned by Sir Eric Harrison was the fact that the first cargo of natural ice, shipped from the United States, arrived in Sydney 118 years ago. In 1855 an immigrant from Scotland, James Harrison, built in Australia the first refrigerator compressor to be produced. To-day we were reaping the benefits of that invention and in a sense Harrison was the pioneer of the Association.

It was a sound arrangement by which the Association represented all sections of the industry thus securing full support. Refrigeration was now one of the leading export industries of Great Britain; from 1948 to 1956 it had shipped about a million domestic refrigerators which with components represented a value of £100 million. The Australian refrigerator industry employed between 6,000 and 7,000 people and now almost all the Australian domestic refrigerators were made in that country. General Motors Holdings were erecting a £4 million factory to produce 40,000 units a year. Sir Eric spoke of the ways in which refrigeration was being employed in Australia and concluded by describing how the Australian Government dealt with industrial disputes.

In the course of his response, the chairman said that last year refrigeration equipment to the value of £850,000 had been sent from this country to Australia. The industry's products had a value of £30 million of which £13 million represented exports. He referred to the use of refrigeration in the testing of jet aircraft engines and in the baking industry.

There had been a tremendous development in refrigerated display counters—a direction in which the Americans had been active for twenty-five years; we were waking up to its importance. The cold soft drink business was also coming along very rapidly.

Domestic refrigerators represented rather more than half their business—£16½ million last year, of which about half was exported. Mr. Carruthers spoke of the great advances made in Italy and Germany and showed how British prices were inflated by the 60 per cent purchase tax; basic prices were not so different from the Italian and German prices. There had been too many changes in Government policy concerning refrigerators as a result of which many factories were running at only half speed.

Automatic Production

A conference on "Automatic Production—Change and Control," organised by the Institution of Production Engineers, will be held at Harrogate from 30th June to 3rd July. Particulars can be obtained from the Institution, 10, Chesterfield Street, London, W.1.

Cyclotron for Medical Research

THE design and construction of a fixed-frequency cyclotron at Hammersmith Hospital was described in a Measurements Section paper which was presented on 21st March before the Institution of Electrical Engineers. The authors, Messrs. J. W. Gallop, D. D. Vonberg, R. J. Post, W. B. Powell, J. Sharp and P. J. Waterton, are with the Medical Research Council. The cyclotron is to be used for research in radiotherapy and radiobiology and for the production of radioactive isotopes for diagnostic, therapeutic and medical research. It is designed to produce external beams of about 200 microamperes of 15 MeV deuterons and 50 microamperes of 30 MeV alpha particles.

Bombardment of a beryllium target by the deuteron beam provides a high-flux source of high-energy neutrons with penetrating powers similar to those of X-rays. The use of an internal target as a neutron source and for isotope production carries with it severe limitations. Maintenance is hampered by the activity induced by the neutron flux in the dee-box and electrode system and by active surface contamination if the target should start to evaporate through accidental overheating. Experimental effort has therefore been concentrated on raising external beam current while design has been directed towards reliability, ease of maintenance and rapid fault location and repair.

The principle of particle acceleration is shown in Fig. 1, and the general assembly of the machine in Fig. 2. In the vacuum-tight dee-box, which is situated between the two poles of an electro-magnet, are two hollow D-shaped electrodes supported on stems extending horizontally into a larger vessel on one side of the magnet. Ions are accelerated from their source at the centre of the electrodes into one of the facing dees, where they follow a circular path until they again reach the gap between the two dees. Reversal of their polarity accelerates the ions across the gap in a repetitive process. With each increment of energy the radius of the path is increased giving it a spiral form.

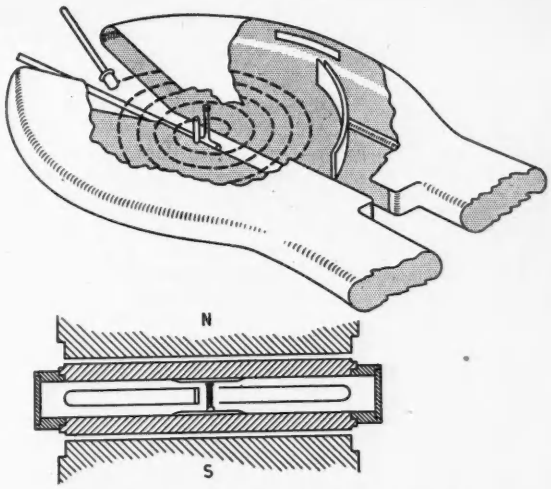


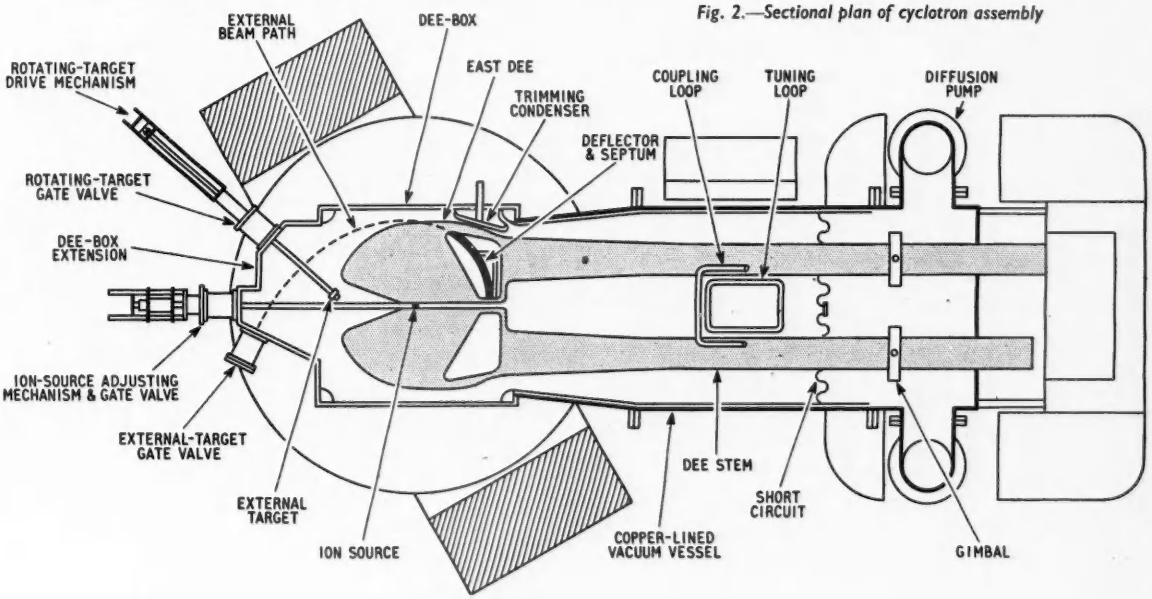
Fig. 1.—Schematic view of cyclotron electrodes

The radiation shield between the cyclotron and the main building is 10ft thick to avoid interference with experiments using low-intensity radiation sources; the remaining walls are 6ft thick for health protection. Acknowledgments are made to C. A. Parsons, Ltd., who designed and built the magnet, and to the Radiotherapeutic Research unit for its collaboration.

DISCUSSION

Dr. Constance Wood (Radiotherapeutic Research Unit, Hammersmith Hospital), who opened the discussion, said that in the treatment of malignant disease radiation was in about two-thirds of all cases, either alone or in combination with surgery, the treatment of choice. The linear

Fig. 2.—Sectional plan of cyclotron assembly



accelerator, essentially a product of British engineers and physicists, enabled deep-seated tumours to be treated with a dose formerly impossible. With the aid of the M.R.C. cyclotron it was hoped to determine the value of neutrons in the treatment of malignant disease. There could be no question of the efficacy of neutrons in destroying malignant cells; what was not known was whether this property could be turned to advantage as compared with other forms of radiotherapy.

Professor J. Rotblat (St. Bartholomew's Hospital) remarked that the cyclotron described was the first in a medical institution. He asked what facilities would be provided for the neutron treatment of patients and whether it was intended to produce protons.

Mr. Walkinshaw (A.E.R.E.) referred to research work which was being done on cyclotrons at Harwell and said that although the design and construction of machines such as that described had been going on for 25 years, they were still ignorant of what was going on at the centre of the cyclotron.

Mr. G. R. Newbery (Radiotherapeutic Research Unit, Hammersmith Hospital) described a few of the radiation measurements made with the cyclotron at Hammersmith, including the calibration of the dee voltmeter and fast neutron dose-rate measurements, using a homogeneous type of ionisation chamber with acetylene as the gas and walls of similar chemical composition, called CH plastic. During the latter measurements a television set in an adjoining building had been rendered unusable.

Mr. M. Snowden (A.E.R.E.) referred to the authors' statement that flaws detected in the Armco iron did not produce measurable effects on the magnetic field. The equilibrium plane, however, had been found to be as much as $\frac{3}{8}$in high in the region of the central cone and $\frac{1}{2}$in low at 12$\frac{1}{2}$in radius, and presumably this change was not due to mechanical tolerances.

Mr. R. Bruce, who has been concerned in the manufacture of the magnets, stated that paper-insulated copper winding of disc coil construction cooled by the circulation of transformer oil had been compared with aluminium windings utilising extruded hollow section conductor with cooling-water circulation. The restricted lengths of extruded copper obtainable would have required numerous joints within the coils which would need to be sound both electrically and hydraulically. Water-cooled aluminium windings had therefore been adopted despite their poorer conductivity.

Dr. J. W. Boag said that the M.R.C. cyclotron was, he believed, the first British machine to be constructed almost exclusively by engineers, a little later than in the U.S.A., but, from personal acquaintance with a good many American machines, he felt sure that it would stand comparison with any of them.

Replying, Mr. Gallop described the arrangements made for the neutron treatment of patients and discussed the possible use of protons. American experience showed a principal difficulty to be in the design of a movable short circuit, which carried up to 4,000 A, so the short circuit of the M.R.C. machine was not made automatically movable from the outside; this could be done later.

Mr. D. D. Vonberg dealt with the problems encountered with the beryllium targets used to produce the neutron beam by an incident beam of deuterons. One difficulty had been cracking on the surface of the beryllium, which had been particularly intense in the region struck by the beam. They believed the trouble to be due to rolling beryllium flakes under great pressure and sintering the material, thus producing a layered body of metal which under successive thermal shocks when coming under the beam caused the material to break up. A copper target of similar shape broke up into arrow-head-shaped cracks which seemed to correspond to the lines of heat flow.

Mr. W. B. Powell agreed with Mr. Walkinshaw on the importance of the behaviour of the particles at the centre of the cyclotron and of the focusing of the beam and described work which the authors had done on this.

Mr. P. J. Waterton dealt with the problem caused by a large l.f. ripple on the r.f. system, which had been cured by using a little pillar to force the edges of the dee apart and keep them restrained so that they no longer oscillated.

NEWS FROM AUSTRALIA

From a Correspondent

THE Australian electrical industry has successfully weathered difficult times over the past eighteen months and is now optimistic about future prospects. It believes that the Government and semi-Government authorities, the major purchasers of electrical equipment, will soon have to considerably increase orders because of the urgent need to expand electrical services for the growing population. In a survey of the industry made by the Industries Division of the Department of Trade, it is stated that, over the past six months, production of heavier types of power transformers has continued at a slightly higher level than in the corresponding period of a year ago, and manufacture of lighter types, which declined earlier in 1956, has since recovered.

The level of production of electric motors has varied between individual States, some manufacturers having decreased output by about 12 per cent, while output of others is down as much as 50 per cent. In contrast to the general movement, however, several companies have maintained previous levels of output, while some producers engaged in the higher h.p. motor field, influenced by the growing demand for units of protected and variable speed control types, have shown production increases.

Production of wires and cables has continued to expand, the rise in the past nine months being some 20 per cent, although in the field of plastic covered cables there have been increases as high as 40 per cent. Output of power and telecommunication paper-insulated, lead-covered cables has remained unchanged, and some producers of rubber and textile covered wires and cables report a downward trend in production. The development of manufacture of aluminium transmission lines and enamelled winding wires is proceeding satisfactorily. The demand for glass fibre and asbestos covered cables is increasing. Slackness in the building trade has caused a lower demand for certain types of wires and l.v. cables.

Electrical Equipment of Australia, Ltd., manufacturers of electric generators, etc., are offering shareholders some 110,000 shares of £1 each at par in the ratio of two-to-five, raising paid capital to £405,000. The company has purchased, for more than £200,000, all the capital of G.M.F. Electric Motors Pty., Ltd.

The net profit of Amalgamated Wireless (Australasia), Ltd., in the year ended 30th June, 1956, rose a further £20,133 (or 7·6 per cent) to £283,976. This is the ninth successive rise in profit.

Cost of Nuclear Power

SIR CHRISTOPHER HINTON'S LECTURE IN SWEDEN

BRIEF references were made in last week's issue to a lecture given recently in Stockholm to the Royal Swedish Academy for Engineering Sciences by Sir Christopher Hinton, K.B.E., F.R.S., managing director, Industrial Group Headquarters, United Kingdom Atomic Energy Authority. In this Sir Christopher traced the development of nuclear power in Great Britain and indicated the probable trend of costs.

He said that they could as a first approximation reasonably expect that the capital cost of nuclear plant would fall in the same way as that of earlier prime movers had done. Taking approximate figures for reactors of the type which had been ordered by the electricity authorities, the cost of power in pence per kWh sent out was made up as follows:—Depreciation (5 per cent interest and 20 years' life) 0·37d; interest on fuel charge (5 per cent) 0·06d; fuel replacement charge (£20,000/T.U.) 0·24d; and operating expenses 0·06d, a total of 0·73d. Deducting 0·07d credit for plutonium in irradiated fuel, the net cost was 0·66d. Thus 65 per cent of the cost of electricity sent out arose from the capital charges. In a conventional coal-fired station only 25 per cent of the cost related to these charges and it followed that reductions in the capital costs of nuclear power plants could lead to a large reduction in generating costs.

Windscale Reactors

More than anything else, the reduction in the cost of steam power plants had been linked with the rise in the initial temperature of the steam cycle. In the case of nuclear power, the maximum can temperature of the original experimental reactor at Harwell (" BEPO ") was conservatively fixed at 200 deg C and the maximum temperature of the air leaving the reactor was 90 deg C. For the Windscale reactors it was agreed that the design should be based on the use of cylindrical uranium rods as fuel elements enclosed in finned aluminium cans and the maximum can temperature was to be 300 deg C, with a maximum uranium temperature at the centre of a rod of 350 deg C. The temperature of the air leaving the reactors was specified as 211 deg C. Over the six years that these reactors had been operating it had in fact been possible to step up the working conditions so that the maximum can temperature was now 340 deg C and the maximum uranium centre temperature 395 deg C.

Moving forward from the Windscale reactors, in which all the heat of fission was wasted, to the Calder Hall reactor, in which the heat was used for the generation of electrical power, the maximum can temperature was stepped up further to 408 deg C with a gas outlet temperature of 336 deg C. Examining the developments which made this rise in operating temperatures possible, he said that in the first place the Calder Hall reactor was cooled by circulating carbon dioxide under a pressure of 7 atmospheres whereas the Windscale reactors were cooled by air at atmospheric pressure. This change was made primarily in order to obtain improved heat capacity in the coolant, but it brought chemical and metallurgical advantages with it. The danger of oxidation of the graphite was considerably reduced. The temperature of the graphite in the Calder Hall reactors varied between 140 and 345 deg C and experimental work showed that even at the higher temperature there would be little decomposition of the carbon dioxide even when allowance had been made for the fact that decomposition might be more marked in the presence of neutron irradiation.

A major advance was made in the decision to use magnesium instead of aluminium cans. It had already been pointed out that uranium and aluminium reacted together chemically and that this reaction became much more rapid as the temperatures rose.

In the Calder Hall reactors the fuel elements were arranged vertically and were stacked one on top of the other, each fuel element bearing the weight of those above it. This arrangement was adopted in order to achieve simplicity and to save the time and experimental work which would have had to be devoted towards achieving an arrangement in which the fuel elements were separately supported.

Reactor Temperatures

Sir Christopher Hinton next discussed the parameters which would be selected to-day for the design of a reactor to go into operation about the end of 1961. He said they should with reasonable confidence select a maximum can temperature of about 450 deg C. This upward step from the temperature of 408 deg C adopted in the Calder Hall reactors would be made possible not by any improvement in the canning material or method of can fabrication, or by improvements in the metallurgy of the uranium fuel elements, but rather by the growing confidence which experience at Calder Hall had given and by independent support of fuel elements and departure from the Calder Hall system, in which these fuel elements were stacked one on top of the other. This advance would therefore be achieved rather by improvement in mechanical design than by advances in metallurgy.

Besides the initial temperature in the heat cycle the other factor which had a major effect on the capital cost was the specific rating of the fuel elements, that was to say, the amount of heat which could be removed from the reactor per kilogram of fuel present in it. Once again,

COST OF POWER FROM NUCLEAR STATIONS
(Pence per kWh Sent Out)

	Commissioning date			
	1960	1970	1980	1990
	d	d	d	d
Depreciation	0·37	0·30	0·26	0·22
Interest on fuel charge	0·06	0·04	0·03	0·02
Fuel replacement charge	0·24	0·13	0·08	0·06
Operating expenses	0·06	0·05	0·04	0·03
Total	0·73	0·52	0·41	0·33
Credit for Pu in irradiated fuel	0·07	0·05	0·03	0·01
Net cost	0·66	0·47	0·38	0·32

COST OF POWER FROM CONVENTIONAL STATIONS
(75 per cent Load Factor)

	Commissioning date			
	1960	1970	1980	1990
	d	d	d	d
Depreciation and interest on capital	0·12	0·11	0·09	0·08
Fuel costs	0·44	0·52	0·60	0·72
Operating expenses	0·04	0·04	0·04	0·04
Total	0·60	0·67	0·73	0·84

the determination of this rating involved compromise; it could always be increased by a sacrifice in the top temperature, since by doing this they could use a bigger temperature difference between the fuel element and coolant. Apart from this, however, specific rating of the fuel in the reactor depended on the type of heat transfer surface which could be used and on the characteristics of the cooling fluids.

In the light of the capital cost predicted, it was possible to calculate the cost per kWh sent out at which nuclear power was likely to be generated in the future. This calculation (see table) showed that by 1970 nuclear power would be appreciably cheaper than conventional power and that this advantage would increase in later years.

An estimate of the cost of generating power in conventional plants was given in a second table. Regarding the cost of coal, Sir Christopher said it must be remembered that, with the passage of time and with increase of demand, less favourable seams had to be worked, so there was some justification for thinking of coal costs in terms of the more expensive pits when considering its marginal replacement by atomic energy and it was suggested that the figures in the table were not unreasonable.

PLANNING OF PLANT MAINTENANCE

IN a paper on "The Theory and Practice of Plant Maintenance with Reference to Planning" which he read before the Association of Supervising Electrical Engineers on 19th March, Mr. H. V. Mather said that the main aims in this sphere should be continuity of service, low cost and high efficiency and safety of personnel and plant. To ensure the first of these in the rayon factory, with which he was connected, duplication had been adopted so that essential plant could be kept running should a fault develop, and this policy was of considerable value to the maintenance programme. Standardisation was another important factor, which contributed to reliability as well as reducing costs, for it enabled the stock of spare parts to be kept to the minimum. The importance of making regular earth and continuity tests and of examining and recording the condition of portable equipment could also not be too strongly stressed.

Most maintenance was carried out either as the result of a complete or partial breakdown, as a consequence of routine testing and inspection, or in accordance with a planning programme whereby complete replacement of parts occurred at intervals. Preventive maintenance which was "planned" necessitated the preparation of a case history of outages or failures for each item of plant. This enabled an estimate to be made of the intervals at which a complete overhaul should be made. From experience based on trial and error a study of economics would dictate to some degree what modifications to this planned system would be necessary from time to time. In many cases it might be worth while spending large sums of money on preventive maintenance, if it were found that a correlation existed between the amount of such work and the service availability.

Viscose Factory Conditions

These principles had been introduced into a large viscose rayon factory, of which the author gave a description, pointing out that the electrical installation must give reliable service where attack by corrosive gases and liquors was experienced. During manufacture the continuous filament yarn was collected in boxes, each of which was driven by a vertical electric motor, there being 100 motors per spinning unit. These motors ran continuously for 168 hours per week in acid-laden air at about 7,000 r.p.m. and were controlled in groups by reversing switches, so that it was necessary to have both primary and secondary busbars. Owing to the presence of acid and hydrogen sulphide, base metal surfaces were rapidly attacked. The motor windings were subjected to considerable temperature rise, owing to differing weights of the yarn and, as a protection against this, the star point was connected through a low-melting-point alloy. A cause of failure from overloading was that some of the liquor (which was carried by the thread into the spinning box) might find its way on to the warm exterior of the motor and crystallise.

Failure Rates

The rate of failure of the motors depended on their speed, the size of the box and the type and condition of the machine on which they were installed. It might average from 2 per cent to 6 per cent or more per week, so that repair must be the subject of organised maintenance. Actually, when a routine maintenance overhaul on a spinning machine was taking place almost every 9 to 12 months the faulty motors and those which had a predicted short life were replaced by others which had been completely dismantled, cleaned, re-assembled and tested, re-assembly being carried out to the same standards as for a new motor.

Maintenance work had grown to a point where the cost of labour and material warranted detailed study and control. It was uneconomical to retain large staffs for emergencies and this could be avoided by planning and systematic inspection. The success of planned preventive maintenance depended not only on the mechanics of the system, but on the wholehearted support of the higher management and the enthusiasm of the engineer in charge. If the latter had authority, in consultation with the electrical engineer, to specify when and how a piece of equipment should be given maintenance and then arrange for the work to be done all should be well and the electrical engineer should be able to concentrate on more technical problems.

Air-Conditioned Telescope

A new British-built telescope on which a number of advance types of electronic receivers will be tested for the first time at the Saint Michel Observatory in the Basses Alpes is air-conditioned to ensure that air in the light path is at a uniform temperature, thus preventing distortions and consequent errors in photographic and spectrographic astronomy.

The main telescope tube has two skins, the inner one comprising fine woven nylon panels and the outer skin sheet duralumin. When the telescope is in use air is extracted from the space between the two skins by fifteen propeller fans made by Woods of Colchester. At the same time atmospheric air is drawn down from outside the observatory dome into the interior of the tube creating a continuous flow of air.

Eight 15in diameter and four 12in diameter fans, all diaphragm mounted, are fitted in the outer casing and three 9in ring guard units are fitted in the base. Together these fans are rated to move approximately 14,440 cu ft of air per minute.

Portuguese Electrical Imports

United Kingdom the Principal Supplier

THE United Kingdom, although challenged since 1949 by increasing West German competition, has kept its position as one of the principal suppliers of electrical goods to Portugal, with the United States, France, Holland and Switzerland. As an outcome of development plans Portugal's electrical imports show an upward trend. They rose from $13·3 million in 1951 to $15·8 million in 1955; in the first half of 1956 the value was about $7·0 million. Exports of the main supplying countries to Portugal (Tables 1 and 2) emphasise the growth of competition in this small but much sought after market.

Table 1.—Portuguese electrical imports ($000)

Country	1954	1955	Jan.-June, 1956
United Kingdom ...	3,741	4,075	1,632
United States... ...	1,486	1,119	673
West Germany ...	2,743	5,125	2,679
Belgium	378	317	278
France	771	1,567	561
Italy	233	187	181
Holland	1,222	1,548	731
Sweden	386	475	232
Switzerland	1,977	1,094	247
Total, incl. others ...	13,264	15,821	6,980

The lack of fuels necessitates the production of electricity mainly by hydro-electric power stations, and steam plants come into production only at peak hours. The variety of technical equipment installed at the various power stations throughout the country and the terms of concessions under which they operate has induced the Government to set up a commission to study the working conditions of the different companies and also to make recommendations regarding economic improvement of the national network.

The principal imports from the United Kingdom consist of telecommunication material, power station equipment, wires and cables, and domestic appliances (Table 3).

Apart from the trade openings in connection with the power projects in metropolitan Portugal there are good possibilities in Portuguese East Africa. (£1=80 escudos.)

Table 3.—Principal United Kingdom electrical exports to Portugal (£000)

Product	1954	1955	First 11 months 1956
Steam and water turbines...	136	24	19
Generating plant	275	79	74
Motors	36	25	38
Transformers	125	19	9
Switchgear	119	70	35
Domestic appliances, incl. heating and cooking	86	118	100
Refrigerators	116	93	106
Wires and cables	272	233	224
Telecommunication equipment	635	1,017	739
Radio and television apparatus	n.a.	216	433

n.a. = not available.

Table 2.—Selected electrical imports by country and commodity group (000 escudos)

Commodity Group	1955
Motors, 3-phase induction up to 500 kg	6,143
From *United Kingdom*	367
,, *West Germany*	2,967
,, *Belgium*	299
,, *France*	523
,, *Switzerland*	964
,, *Sweden*	452
Transformers, up to 2,500 kg	20,985
From *United Kingdom*	2,793
,, *United States*	2,091
,, *West Germany*	5,202
,, *France*	2,710
,, *Holland*	2,562
,, *Sweden*	1,067
,, *Switzerland*	2,721
Switchgear and rheostats	17,958
From *United Kingdom*	3,837
,, *United States*	1,050
,, *West Germany*	4,867
,, *France*	2,484
,, *Switzerland*	3,558
Condensers, fixed and variable up to 2 kg	2,987
From *United Kingdom*	805
,, *United States*	387
,, *West Germany*	617
,, *Holland*	587
Vacuum cleaners, floor polishers and parts thereof	9,972
From *United Kingdom*	2,022
,, *West Germany*	2,074
,, *Holland*	2,401
,, *Sweden*	3,006
Flat irons	4,827
From *United Kingdom*	2,597
,, *West Germany*	1,176
Clothes washing machines	4,277
From *United Kingdom*	2,360
,, *United States*	236
,, *West Germany*	1,155
Refrigeration chests, up to 200 kg ...	35,222
From *United Kingdom*	6,348
,, *United States*	14,012
,, *West Germany*	11,737
,, *Sweden*	2,001
Ditto, above 200 kg	1,281
From *United Kingdom*	181
,, *United States*	397
,, *France*	400
,, *Sweden*	218
Resistances for electric heating appliances	657
From *United Kingdom*	236
,, *West Germany*	200
Meters	11,250
From *United Kingdom*	1,092
,, *West Germany*	5,837
,, *Switzerland*	2,227
Radio-telephone and telegraph, TV receivers and appliances	68,973
From *United Kingdom*	5,285
,, *United States*	2,309
,, *West Germany*	44,349
,, *Italy*	1,596
,, *Holland*	12,523
Loud speakers	3,347
From *United Kingdom*	956
,, *United States*	396
,, *West Germany*	599
,, *Holland*	939
Telephone apparatus and components ...	7,603
From *United Kingdom*	4,771
,, *West Germany*	791
,, *Sweden*	1,053
Private telephone installations, up to 50 internal lines	126
From *United Kingdom*	108
Electronic tubes	8,591
From *United Kingdom*	1,652
,, *United States*	3,421
,, *Holland*	2,052
Lanterns and projectors, n.e.s.	19,572
From *United Kingdom*	4,486
,, *United States*	1,497
,, *West Germany*	7,926
,, *France*	2,074
,, *Holland*	1,053
,, *Hongkong*	1,155
Lamps, filament	12,219
From *United Kingdom*	898
,, *United States*	333
,, *West Germany*	5,166
,, *Holland*	4,877
Ditto, n.e.s....	3,552
From *United Kingdom*	310
,, *United States*	982
,, *West Germany*	503
,, *Holland*	1,251
Accumulators (lead)	2,990
From *United Kingdom*	811
,, *United States*	583
,, *West Germany*	1,162
Ditto (others)	2,234
From *United Kingdom*	175
,, *France*	1,341
Batteries (dry cell)...	2,545
From *United Kingdom*	673
,, *West Germany*	1,555
,, *Denmark*	118
Cables, copper, uninsulated	387
From *United Kingdom*	27
,, *West Germany*	311
Cables and wires, without metal armour or sheath covered with textile yarn, fabric, etc., weighing up to 120 grm/metre	2,254
From *United Kingdom*	1,435
,, *West Germany*	566
Ditto, weighing more than 120 grm/metre	267
From *United Kingdom*	113
Cables and wires with metal armour or sheath whether or not covered with other materials weighing up to 1,500 grm/metre	4,342
From *United Kingdom*	1,291
,, *West Germany*	2,311
Ditto, weighing from 1,500 grm/metre up to 5,000 grm/metre	8,334
From *United Kingdom*	1,291
,, *West Germany*	2,311
Ditto, weighing more than 5,000 grm/metre	29,772
From *United Kingdom*	13,157
,, *West Germany*	8,673
,, *France*	2,474
,, *Holland*	5,326
Copper wire, enamelled up to 0·6mm dia.	1,474
From *United Kingdom*	533
,, *West Germany*	811
Ditto, over 0·6mm dia.	3,485
From *United Kingdom*	1,782
,, *West Germany*	1,600
Copper wire, rubber insulated	124
From *United Kingdom*	120
Insulated cables and wires	2,106
From *United Kingdom*	1,293
,, *West Germany*	348
,, *Belgium*	237
Cables and wires, n.e.s.	2,099
From *United Kingdom*	726
,, *West Germany*	952
Insulating material	1,207
From *United Kingdom*	101
,, *Sweden*	716

INDUSTRIAL NEWS

Wages in the Contracting Industry

On the first full pay day following 24th March wages in the Scottish electrical contracting industry were increased by 2½d per hour. Present rates are: journeymen, 4s 7d per hour; armature winders, 4s 8d per hour.

Negotiations in England and Wales on the E.T.U.'s claim for an increase of 7½d per hour in the provinces and 5½d in London was formally lodged in November, referred to the wages sub-committee in February and, after a meeting on 6th March, deferred to the meeting of the N.J.I.C. being held to-day (Friday). It was, however, agreed to increase country allowance by 1s per night, to 9s per night, and to apply to all districts a uniform rate of 80 per cent of the journeyman's rate, plus the hourly addition, for all adult electricians' assistants (mates), as from 1st April.

National Inspection Council

We have received a copy of the first leaflet issued by the National Inspection Council for Electrical Installation Contracting (13, Victoria Street, London, S.W.1). It is directed towards the public, telling them what the Roll of Approved Contractors is and what are the qualifications required in applicants for enrolment. The object, of course, is to persuade members of the public to place their installation work with approved contractors to secure competent and safe work.

The Council has also sent us a sample of an ingenious "sticker" which it has available for display by approved contractors. This bears the Council's device and it can be mounted on any smooth non-porous surface. The stickers cost 3s each and eight are supplied for £1.

It is hoped that the first edition of the Roll of Approved Contractors will be available for publication by the end of April; it will give the names of between 3,000 and 4,000 contractors.

Lord Mills at E.D.A. Luncheon

Lord Mills, K.B.E., Minister of Power, will be the principal guest at the annual luncheon of the British Electrical Development Association, at the Savoy Hotel, London, on 7th May. Lord Mills will propose the toast of "Electrical Development" to which Viscount Chandos, D.S.O., M.C., president of E.D.A., will reply.

Hire Purchase Regulations Amended

Traders will in future be prohibited from arranging loans to enable prospective customers to pay the initial deposit or the nine months' advance rental on goods they buy or hire. This tightening up of the restrictions will be given effect by two new Board of Trade Orders which come into operation on 4th April.

The new Hire-Purchase and Credit Sale Agreements (Control) Order prohibits any arrangement by which the dealer, the finance company, or the manufacturer agree to lend money to cover the initial deposit. A deposit will now be required if a person is in possession of goods for fourteen days or more in anticipation of entering into a hire-purchase or credit sale agreement. Certain minor changes have also been made to the schedule of goods to which the Order applies but no additional goods are controlled nor is there any change in the hire-purchase terms.

The New Control of Hiring Order contains similar provisions regarding the payment of the nine months' advance rentals with borrowed money. Goods which are at least three years old at the time of the hiring agreement and which have been let on hire by their owners for at least twelve months during the last three years are now exempt from control.

The two Orders are the Hire Purchase and Credit Sale Agreements (Control) Order, 1957 (S.I. No. 430) and the Control of Hiring Order, 1957 (S.I. No. 431). They can be obtained from H.M. Stationery Office, price 6d (post free 8d) and 4d (post free 6d) respectively.

British Plastics Federation

Addressing the annual general meeting of the British Plastics Federation in London on 20th March, Mr. W. C. Waghorne, the retiring president, said that as a result of a visit to Russian plastics factories last October by representatives of three member firms, a return visit from the U.S.S.R. plastics industry, led by Mr. Nicolaevitch Alexandz Nicolai, head of Russia's plastics industry, would probably take place in April. Mr. Waghorne referred to the expanding exports of British plastics. When the Federation was formed twenty-two years ago the export tonnage of plastics materials was probably not more than 3,000 to 4,000 tons, whereas for 1956 alone it was 98,000 tons, an increase of nearly 13,000 tons on 1955.

Architects and Lighting

At the third and last of the 1957 series of conferences for architects on electric lighting arranged by the Lighting Service Bureau last week Mr. E. B. Sawyer, manager of the Bureau, presided and Mr. T. S. Jones spoke on the lighting of industrial buildings.

After outlining the principal factors influencing the effectiveness of a lighting installation, Mr. Jones touched upon such points as shadows, silhouettes, surface brightness, angle of lighting and contrast. The planning of lighting in relation to factory structure, maintenance of lighting and special situations were other subjects dealt with, reference also being made to costs.

The ensuing discussion was opened by Mr. E. D. Jefferiss Mathews, O.B.E., F.R.I.B.A., and there were four other speakers.

British Trade Drive in South Africa

The British Manufacturers' and Representatives' Association of South Africa celebrates its jubilee this year, and to mark the event it is proposed to hold British Trade Weeks in South Africa. The scheme is being sponsored by the Federation of British Industries and the Association, and is being supported by Government Departments and other bodies. There will be three trade weeks, in Cape Town (29th April-4th May), in Durban, Natal (late June), and in Johannesburg (in September). Displays of British goods and of South African goods made from British materials will be arranged by all the large shops and departmental stores. A number of other events and attractions have been arranged during these weeks, and among the supporting arrangements, the F.B.I. Scholarship Scheme, which brings promising young engineers to the United Kingdom for training, has been extended to South Africa.

At a Press conference last week, Dr. J. E. Holloway, High Commissioner for the Union of South Africa, said that the industrial development of South Africa did not threaten exports from the United Kingdom, and would in fact provide an expanding market. It would, however, alter the nature of imports.

Atomic Plant for Germany

A closed-cycle boiling water reactor for operating a 15 MW turbo-generator has been ordered by the Rheinisch-Westfalisches Elektricitätswerk A.G., for erection in the Ruhr, from Mitchell Engineering, Ltd., London, which is associated with A.M.F. Atomics, Inc., of New York. The reactor itself and control equipment will be provided by the American company while Mitchell Engineering will supply the reactor shell, heat exchangers and other equipment on the reactor side of the plant.

The primary steam will be at 900 lb/sq in and 530 deg F and secondary steam at 600 lb/sq in and about 500 deg F.

The generating plant will be of German manufacture and the civil engineering work will be carried out

Interested visitors from overseas inspecting a model of the British Industrial Pavilion at the 1958 Brussels World Exhibition in one of the windows of Crown House, Aldwych, London

by the Germans. The value of the reactor order is put at about £1,890,000 and the cost of the complete station at nearly £4 million. The work is to be completed by 1959.

British Plastics Exhibition and Convention

Leading authorities on plastics from all parts of the world are to address a convention to be held in conjunction with this year's international British Plastics Exhibition to be held at Olympia, London, from 10th to 20th July. Subjects to be discussed will include the latest extrusion and injection moulding techniques, and recent developments in polythenes, polyvinylchloride and foamed plastics materials. Tickets for all sessions may be obtained free of charge from the organisers, *British Plastics*, Dorset House, Stamford Street, London, S.E.1.

Jackson Boilers' New Factory

Work has begun on the site of a new factory in Elland Road, Leeds, for Jackson Boilers, Ltd., and the company hopes to be in occupation within about twelve months. The new factory, which will have a total floor space of nearly 60,000 sq ft, is to be devoted to the manufacture of café water boilers, tea brewers and coffee makers and will replace the four Leeds factories and storage depots at present occupied.

Export Credits Guarantees Extended

Improvements in insurance cover for United Kingdom exporters have been announced by the Export Credits Guarantee Department. From 1st April a completely revised form of cover against payment risks will be available to exporters of goods sold on terms of payment up to two years' credit. The principal changes are: Once shipment has been made E.C.G.D. pays 95 per cent (hitherto 90 per cent) of all specified losses outside the control of buyer or seller. Claims arising out of "transfer" or "political" risks (e.g. blockage of exchange by buyer's government) will be settled after four months (hitherto six); claims due to default on goods accepted will be paid after six months (hitherto twelve). For the first time limited cover will be given on default by the buyer before acceptance of the goods. Under this heading the exporter must bear a first loss of £20 on every £100 of invoice price: E.C.G.D. then bears 85 per cent of any loss within the next £40.

Nuclear-Powered Submarine

The English Electric Co., Ltd., has received an order from the Admiralty for the design and manufacture of the main propelling steam turbines and condensers for Great Britain's first nuclear-powered submarine. The order covers the prototype machinery, which will be tested in a land-based hull and also the turbines for the first ship of this type.

The submarine is to be built at the Vickers-Armstrongs yard, Barrow-in-Furness. The reactor and associated equipment are being designed by Rolls-Royce, Ltd., and the steam generators and heat exchangers by Foster Wheeler, Ltd. The propulsion unit will be a pressurised water reactor, as in the first American nuclear submarine, *Nautilus*.

Russian Coal Industry

The Technical Mission of the National Coal Board, which visited the Soviet Union in 1956 to study Soviet coal mining methods, has now issued its report—"The Coal Industry of the U.S.S.R." This is based on the Mission's observations in the Kuzbass, Donbass and Rostov coalfields, and deals mainly with what is best in Soviet mining techniques. A chapter on engineering briefly describes electrical equipment used underground. The publication, which is profusely illustrated, is obtainable from the N.C.B., Hobart House, S.W.1, price 7s 6d (8s post free). The appendices to the report will be published separately.

Industrial Safety Course

The second training course for electrical installation, repair and maintenance engineers organised by the Birmingham and District Industrial Safety Group was attended by representatives of firms from all parts of the United Kingdom and covered a very wide field of interests. It was under the general direction of Mr. G. L. Leighton, H.M. Electrical Inspector of Factories for the South and West Midland Divisions of the Factory Inspectorate, who lectured on various subjects including the use, testing and maintenance of portable tools and the general incidence of electrical accidents. Mr. S. J. Emerson, H.M. Senior Electrical Inspector of Factories, gave papers on the "Electricity Regulations" and the relevant sections of the Factories Act, as well as demonstrating recent developments in electrical interlocks and safety devices. Dr. C. R. Lowe, medical officer of the G.E.C., talked on the effects and treatment of electric shock as well as giving practical demonstrations of various methods of artificial respiration, and Mr. R. Hillier, H.M. Superintending Inspector of Factories for the South Midlands Division, dealt with the precautions which should be taken when dealing with electricity in explosive and inflammable atmospheres.

A similar course is planned to be run on 27th-28th August. Details of this and other courses planned may be obtained from the manager of the Industrial Safety Training Centre, 22, Summer Road, Acocks Green, Birmingham, 27.

Irish Electrical Traders

A criticism of import duties and indirect taxation were the subject of an address by Mr. J. W. Smythe, president of the Society of Irish Electrical Traders, at the annual meeting of the Society in Dublin. Mr. Smythe said that the two special import levies began life as an effort to redress the adverse balance of payments but were continuing to live in their more truthful form of indirect taxation. The Society had outlined a scheme whereby electrical fittings for industry could be imported free of levies but the Minister for Finance could not see his way to agree to it. The past year had seen a drastic increase in the credit squeeze which had affected the members generally, but the Society was in a healthy condition, numerically and financially.

The following officers were elected for 1957-58:—President, Mr. A. P. Haslam; vice-president, Mr. T. C. Lenehan; hon. treasurer, Mr. C. W. Symmonds (Falk, Stadelmann & Co., Ltd.); director-secretary, Mr. M. J. O'Connor.

Special Telecommunication Cables

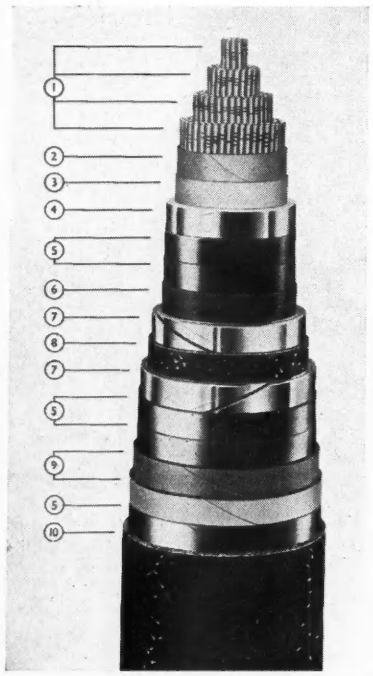
The British Transport Commission has announced the award of a £290,000 contract to British Insulated Callender's Cables, Ltd., for the supply and installation of telecommunication cables on the Crewe-Manchester line as part of the railway modernisation programme. This follows the recent award to the B.I.C.C. Group of the supply and erection contract for electrification of this line. Both audio and carrier types of cable are included in the installation, together with distribution cabinets and trackside telephone cabinets.

Severe problems are set for the telephone cable designer by the presence of a 25 kV a.c. traction system running in close proximity to telephone cables throughout their length. In conven-

tional cables the voltages induced by high load or fault currents in the overhead traction system might be sufficiently high to cause damage to the insulation of the cable and connected apparatus, or to endanger the lives of people using the railway telephone system.

It is therefore necessary to provide heavy screening to keep the induced voltage on the cables within safe limits. The manufacturers have developed for this purpose special cables having aluminium sheaths of sufficient thickness to give a low longitudinal resistance, and provided with a multiple steel tape armour of selected material to raise the external sheath impedance. The earthing of the cable sheaths is of the utmost importance in ensuring the effectiveness of the screening, and the makers' system of deep driven earthing rods is eminently suited to provide earthing points of low resistance at regular intervals.

It is of paramount importance that both the steel tapes and the aluminium sheath should be securely protected against corrosion, both from earth currents and local soil conditions, because of their vital importance for screening purposes. Very careful attention has therefore been paid to the protective serving which is applied over the steel tapes, this being the patent p.v.c. and rubber sandwich type which the company introduced some time ago for use on power cables. A point of interest is that the security of the protective serving is tested by applying a voltage of 10 kV between the steel tapes and the coating of graphite with which the cable is finished: this means that a final test can be made after the cables have actually been laid so that the state of the serving need not be in doubt.



Manchester–Crewe railway electrification : 104-pair 40-lb dry-core insulated telephone cable

1. Long-distance star quads. 2. Belt papers. 3. Lapped cotton tape. 4. Aluminium sheath. 5. P.v.c. tape. 6. Compounded cotton tape. 7. Mild steel tapes. 8. Compounded hessian. 9. Rubber tape. 10. Compounded hessian with graphite finish

Fair Trading Policy Amendments

Printed amendment slips are now available for pasting in the Electrical Fair Trading Policy relating to the recent changes in terms to Government Departments and in street lighting lanterns (*Electrical Review*, 22nd February). These may be obtained gratis from the secretary, Mr. A. S. Lowe, Electrical Fair Trading Council, Sardinia House, Kingsway, London, W.C.2.

G.E.C. Sales Competition

The final of a "How to Sell" competition organised by the General Electric Co., Ltd., embracing the whole of the Midlands area, was held in Birmingham on 19th March. Each competitor had to speak to an imaginary customer for a maximum time of three minutes, on either the G.E.C. 4 cu ft refrigerator or the G.E.C. "Quality" cooker.

The preliminary contests were held in four centres—Birmingham, Wolverhampton, Coventry and Worcester. Each contest was preceded by a talk by Mr. R. E. Ruberson of the Head Office Sales Department.

There were 102 entrants and the winner and runner-up at each centre went forward to the final, and each received a prize.

The winner was Mr. K. A. Brabin (C. Shaw, Ltd., Birmingham); Mrs. E. Higginson (East Midlands Electricity Board, Tamworth) was second and the third place was tied for by Mr. J. Thompson (Midlands Electricity Board, Solihull) and Mr. H. W. Lowe (M.E.B., Quinton). The prizes, of £50, £25, and £10 which was shared, were presented by Mr. W. Lewis, chairman, Midlands Electricity Board. The judges at the final were: Mrs. A. L. Hayes (Electrical Association for Women), Mr. J. H. Boardley (Birmingham branch chairman, Electrical Contractors' Association) and Mr. E. Braathen (Birmingham Sub-Area manager, Midlands Electricity Board).

New Pye Factory at Airdrie

The building of a new 45,000 sq ft factory at Martin Street, Airdrie, for Pye Scottish Telecommunications, Ltd., was officially started on 21st March when the ceremony of cutting the first sod was performed by the Provost of Airdrie. The new factory where, it is anticipated, between 400 and 500 people will be employed, is being constructed by Scottish Industrial Estates, Ltd., for the Board of Trade, who will in turn sell it to Pye, Ltd. It will permit a fourfold expansion of the present activities of Pye Scottish Telecommunications at Airdrie and will be ready for occupation in March next year.

Speaking at a Press conference after the ceremony, Mr. J. W. Dalgleish, chief engineer of Pye, Ltd., and a director of Pye Scottish Telecommunications, said that the present factory, employing about 130 workers, was now producing 1,000 radio receivers weekly and roughly one-third of these went to overseas customers.

A design group employing twelve engineers and draughtsmen had also been started and it was intended to expand this quite quickly. This group was engaged in the design of control equipment and instrumentation for nuclear power projects and similar work in the wider industrial field. It was their intention, he said, to have at Airdrie a fully-integrated engineering business which would enable them to train youngsters as fully-qualified engineers.

Australian Tariff Preferences

The *Board of Trade Journal* of 23rd March publishes lists of goods in respect of which the Australian Government has agreed to guarantee margins of preference for those of United Kingdom origin. Many classes of electrical goods are included and in general they enjoy a greater margin of preference than the guaranteed figures.

Tungsten Ore Disposal

The Board of Trade announces that its trading stocks of tungsten ores have been virtually disposed of during the last few years, and that the total amount at present available for disposal is about 500 tons metal content. The Board's selling agent, British Tungsten, Ltd., has instructions to dispose of this quantity gradually, as required, so as to avoid undue disturbance of the market.

Trade Announcements

Perihel, Ltd., and **Tellux, Ltd.,** are moving into new and more commodious premises and from 1st April the warehouse, factory, showrooms and administrative offices will be at 146, New Cavendish Street, London, W.1 (telephone: Langham 2411-3).

A five-storey building at 39-87, Cheapside, Liverpool, has been purchased by the **Automatic Telephone & Electric Co., Ltd.,** for use in connection with its expansion in the electronic field.

The Darlington branch of **Crompton Parkinson, Ltd.,** has moved to King Street (telephone: Darlington 5285/6).

Priestman Brothers, Ltd., have moved their London office to Great West Road, Brentford, Middx. (telephone: Ealing 6717/8). The new premises include the sales office, parts store, service depot and excavator showroom.

GENERATION AND DEVELOPMENT

Revision of South Wales Tariffs

The South Wales Electricity Board has announced increases in its domestic, commercial (block rate) and farm tariffs which will come into force after the next meter readings following 31st March. The variations in the tariffs are as follows:—

In addition, the discount of 2½ per cent at present allowed to quarterly meter consumers for prompt payment is to be discontinued, and a rental of 3s 6d a quarter is to be charged to consumers taking supplies through a prepayment meter.

Domestic Tariff.—An increase in the primary rate from 5¼d to 5½d/kWh and an increase from 10 to 12 in the number of kWh per room chargeable at that rate. This means that the minimum assessment will be increased from 20 to 24 kWh and the maximum from 100 to 120 kWh a quarter.

Commercial (Block Rate) Tariff.—Primary rate increased from 5¼d to 5½d/kWh and the number of kWh chargeable increased as follows:—Shops, etc., from 5 to 6 kWh for each 15 sq ft or part thereof; schools, colleges, public halls, etc., from 5 to 6 kWh for each 100 sq ft or part; and other commercial premises, from 5 to 6 kWh for each 30 sq ft or part. The minimum size of the block is increased from 20 to 24 kWh.

Farm Tariff.—Similar increases to those proposed for domestic consumers and the size of the secondary block covering supplies for farming purposes increased from 400 to 480 kWh a quarter at 2¾d.

Residuary Tariff.—An increase in the rate from 5¼d to 5½d/kWh.

H.V. Lines in Cumberland

Cumberland County Council has approved plans by the North Western Electricity Board for the construction of 132 kV lines from Windscale to Calder Hall and from Harker to Spadeadam.

Boards' Sales in February

The accompanying table shows the sales of the twelve Electricity Boards in England and Wales during February. As will be seen there was a decrease in the national figures compared with February, 1956, of 11·7 per cent, but when corrected for weather conditions and working days, there is actually an increase of 5·7 per cent.

Kerry Turf-Fired Station

The South Kerry Turf Producers' Association has been informed by the Electricity Supply Board that the turf-burning generating station at Deelie, Cahirciveen, is expected to go into production early next July. Some 30,000 tons of turf a year will be required. The price offered is 45s per ton delivered and unloaded at the station, but the Association is endeavouring to obtain an increase in this figure.

Request for Improved Supply

Ashington (Northumberland) U.D.C. has asked the North Eastern Electricity Board to improve the electricity supply. The town has no gas supply and the existing network is not able to carry the load, which has risen considerably in recent years. The Board says it is doing all it can to meet the extra load, and has asked the Council for its co-operation in allocating sites for additional substations.

Dust Emission

Newcastle-on-Tyne City Health Committee has protested to the Central Electricity Authority against the dust nuisance from the new Stella power stations near Newcastle-on-Tyne.

Large Boiler Feed Pumps

The Harland Engineering Co., Ltd., has received a contract, valued at £276,000, from the Central Electricity Authority for four boiler feed pump groups for the new West Thurrock power station, Essex. These sets, which consist of booster and boiler feed pumps with motors of 1,650 h.p. and 6,500 h.p. per set, are likely, it is stated, to be among the largest of their type ever commissioned in Europe. The turbo-generators to be installed in the station will be of 200 MW capacity.

Midlands Price Increase

The Midlands Electricity Board on Tuesday announced increases in electricity charges affecting all its 1,350,000 consumers. In a statement announcing the increases, the chairman of the Board, Mr. W. S. Lewis, said that all the extra costs, amounting to £3,000,000, which had led to these increases were outside the Board's control. Details of the new charges, which include an increase in the primary rate of the standard two-part block tariff from 4½d to 5¼d per kWh, will be given in our next issue.

OVERSEAS

Shawinigan Plant Used to Maximum Capacity

Reporting to shareholders at the company's annual meeting in Montreal on 27th March, Mr. J. A. Fuller, president of the Shawinigan Water & Power Co., said that it was necessary last year to operate all generating facilities at their maximum capacity without the normal margin of reserve. The total output was 9,898 million kWh, an increase of 7·2 per cent over 1955. The primary power peak load on the system rose from 1,500 to 1,600 MW. New consumers connected during the year numbered 8,942, making the total at December last 231,759 in 612 municipalities. The average annual consumption by residential consumers rose from 2,380 kWh in 1955 to 2,685 kWh last year.

Reflecting the increasing electrical requirements of the territory in Quebec which the company serves, capital expenditure on new construction amounted to nearly $24 million (£9 million) against $15 million (£5·6 million) in the previous year. The largest item was $9·7 million for work at the Beaumont hydro-electric development, the company's seventh on the St. Maurice River. Construction of this new 246 MW station was started in the spring and the first of its six units is scheduled to go into service late in 1958, with full operation early the following year. The total cost of the new plant with allied installations is expected to be about $56 million (£21 million).

After providing for dividends on preferred shares, net earnings for 1956 were $10·3 million, or $4·25 per common share (against $3·48 in 1955).

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for February (million kWh)			Twelve Months Totals Ended 28th/29th February (million kWh)		
	1956	1957	Inc. or Dec. %	1956	1957	Inc. or Dec. %
London	832·3	664·5	—20·2	6,741·2	6,896·7	+ 2·3
South Eastern	516·8	404·4	—21·8	4,176·9	4,418·1	+ 5·8
Southern	589·5	506·4	—14·1	5,008·7	5,410·0	+ 8·0
South Western	285·8	245·8	—14·0	2,561·3	2,742·3	+ 7·1
Eastern	786·0	658·2	—16·3	6,659·5	7,072·0	+ 6·2
East Midlands*	604·6	546·1	— 9·7	5,742·2	6,045·7	+ 5·3
Midlands*	809·0	707·9	—12·5	7,553·7	7,732·6	+ 2·4
South Wales*	416·3	395·5	— 5·0	4,389·0	4,528·5	+ 3·2
Merseyside and North Wales*	450·0	422·3	— 6·2	4,509·9	4,781·9	+ 6·0
Yorkshire*	749·2	709·8	— 5·3	7,454·4	7,878·8	+ 5·7
North Eastern*	418·8	402·0	— 4·0	4,284·4	4,539·9	+ 6·0
North Western*	807·3	733·5	— 9·1	7,974·8	8,236·6	+ 3·3
Total all Area Boards	7,265·6	6,396·4	—12·0	67,056·0	70,283·1	+ 4·8
Direct Supplies by Central Authority	178·9	179·6	+ 0·4	1,929·7	2,183·5	+13·2
Grand Total	7,444·5	6,576·0	—11·7	68,985·7	72,466·6	+ 5·0
Mainly Industrial Areas*	4,255·2	3,917·1	— 7·9	41,908·4	43,744·0	+ 4·4
Mainly Non-Industrial Areas	3,010·4	2,479·3	—17·6	25,147·6	26,539·1	+ 5·5

* Those in which industrial consumers took over 50 per cent of the total sales in the preceding financial year.

NEW ELECTRICAL EQUIPMENT

Signal Generators

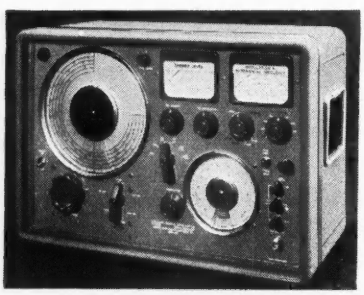
MARCONI INSTRUMENTS, LTD., St. Albans, have introduced a new f.m./a.m. signal generator, TF 1066/1, of greater versatility and offering the additional facility of a.m. outputs. The carrier frequency range extends from 10 to 470 Mc/s and the output can be set at any level between 0·2 μV and 200 mV. F.m. is monitored and variable up to a maximum of 100 kc/s deviation. A.m. is monitored and variable to any depth up to at least 40 per cent.

Facilities for incremental tuning include stepped as well as continuous control. The stepped control of incremental frequency provides fixed positive or negative shifts of 5, 10, and 15 kc/s; the advantage of this feature is the ease with which rapid checks of receiver bandwith can be made during production testing.

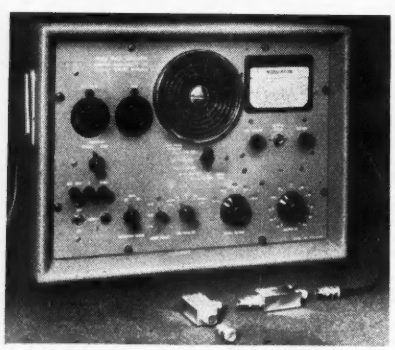
Precision adjustment of carrier frequency is made easy by the inclusion of a fine tuning control, which covers a range of approximately 25 kc/s. The frequency stability is such that the carrier frequency drift is no greater than 0·0025 per cent in a 10-minute period, a figure which corresponds to less than 800 cycles per minute at 300 Mc/s.

Another addition to the company's range is the f.m./a.m. signal generator Type TF 995A/2. The frequency range of this compact, a.c. mains operated, transportable instrument extends from 1·5 to 220 Mc/s in five bands and there is a built-in crystal calibrator for use above 13·5 Mc/s. A precision slow-motion mechanism is employed for the main tuning drive and a directly-calibrated incremental tuning control for making bandwidth measurements has been incorporated.

The open-circuit output level is variable, in 1 dB steps, from a minimum of 0·1 μV to a maximum of 100 mV at 52 ohms and 200 mV at 75 ohms. The output may be c.w., frequency modulated, amplitude modulated, or simultaneously both frequency and amplitude modulated. The modulation, obtained either from an internal 1,000 c/s oscillator or from an external source, is variable to maximum frequency deviations ranging from 25 to 600 kc/s for f.m., and to depths up to 50 per cent for a.m.



Marconi Instruments f.m./a.m. signal generators: (above) Type TF 1066/1 and (below) Type TF 995A/2



Solenoid Valve

A solenoid-operated valve introduced under the name "Flomite" by BERFIELD INDUSTRIES, LTD., Stratford House, Stratford Place, London, W.1, is intended for applications which require a small flow rate of not less than 0·2 g.p.m. or more than 0·6 g.p.m. of water. It is a directly operated, normally closed, self-closing valve which will deliver and maintain a rate of fluid flow. The valve may also be used on air. There are four basic assemblies and six choices of controlled flow rates.

Triple Pole Switchfuse

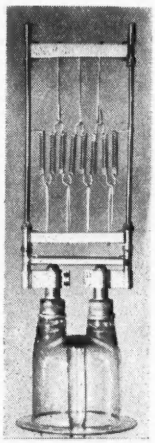
A triple pole switchfuse manufactured by BILL SWITCHGEAR, LTD., of Birmingham, incorporates a number of improvements and additional features, and has been designed to control motors up to 5 h.p. This switchfuse, known as the Radette Q1438 Mark II, has quick make and slow break action, eliminating arcing at the contacts; provides ample wiring room, "through" wiring being arranged under the switch base; and no dismantling of the switch mechanism is required. It has a solid "Fortol" brush bar, eliminating the possibility of breakdown to earth, and it has a durable stoved enamel aluminium finish.

Speaker/Microphone Control Box

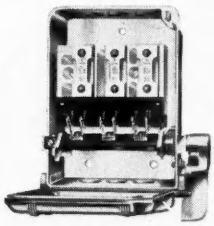
The "Clearcall" Type L4B loudspeaker/microphone control box available from the BRITISH THOMSON-HOUSTON CO., LTD., Rugby, is especially suitable for use under noisy and dusty conditions, and where noise levels are particularly high the speaker may be reinforced in the control box by means of an external horn type loudspeaker "beaming" over the working area.

The unit is fitted with the "Clearcall" M28M metal-diaphragm microphone. A tapped transformer in the control box enables the speaker volume to be adjusted on installation to suit local requirements. No power supply is connected to the control box; a six core cable is required to link the boxes together or to connect them separately to a central control point on the "Clearcall" amplifier, the rating of which will depend on the number of control boxes in the system.

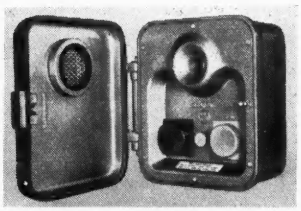
Berfield Industries' "Flomite" valve



Filament assembly of the "Osram" 10 kW studio lamp showing the use of inverted copper thimbles



Bill "Radette" Q1438 triple pole switchfuse



B.T.H. speaker/microphone control box

Large Studio Lamp

The GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, has recently introduced a new 10 kW studio lamp which is believed to be the largest lamp in regular production in Britain. It incorporates a modified cap assembly which makes it more rugged and easier to handle and fully interchangeable with lamps of the previous design which incorporated bi-post bases.

Copper thimbles, similar to those in the standard bi-post base, are used in the new lamp to provide a seal for the lead connections. They support the

filament assembly and are connected by flexible leads to the solid brass pins at the base of the cap. These pins are mounted in a "Mycatherm" disc which forms the base of the cap, and their dimensions and spacing are identical with those of the standard bi-post base.

The new cap is secured firmly to the neck of the lamp and the glass seal is therefore relieved of all strains produced when the lamp is being inserted or removed from its housing. This filament support system is already being used successfully in "Osram" lighthouse lamps.

Production Analyser

A recent introduction by HEADLAND ENGINEERING DEVELOPMENTS, LTD., 164-168, Westminster Bridge Road, London, S.E.1, is the "Meetap" production analyser. The apparatus consists of a power pack, which can be fixed in the vicinity of a machine and will operate up to six analysers; the analyser, which is fixed to the machine itself and is controlled by the operator; the machine switch (the type will vary according to whether the machine commences production as soon as the motor is started, or whether it is of a type which can be running without producing); and the warning signal (sound or visual).

On the analyser panel are mounted 12 meters to record actual production time, signal time, and any 10 coded typical causes of production stoppage. A 10-position switch, numbered to correspond with the coded stoppage causes, has also unnumbered intermediate positions.

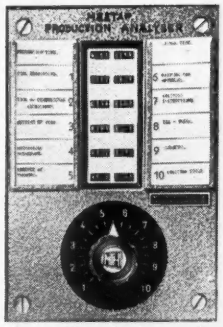
When the indicator on the switch is set at any intermediate position production time will be logged, minute by minute, on the production meter. If production stops, the warning signal operates and its duration is logged on the signal meter. The signal will continue to operate until the machine minder turns the switch indicator to the particular number denoting the cause of the stoppage. The appropriate "cause of stoppage" meter then proceeds to log the duration of the idle time, minute by minute. As soon as production recommences, the meter again records the production time.

Each operator, on commencing a shift, checks the meter readings and records these on the appropriate part of an analysis card. At the end of every working period, day, or week, the new readings are recorded on the card and, by subtracting these readings, the actual production time, signal time and various "cause of stoppage" times are obtained.

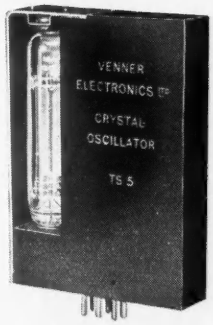
Crystal Oscillator

A packaged crystal oscillator incorporating transistors is now available from VENNER ELECTRONIC PRODUCTS, LTD., Kingston By-Pass, Surrey. It has two 10 kc/s outputs, one sinusoidal and the other square. An XY flexure quartz crystal is used to provide accurate control, with a preset capacitor external to the block for initial frequency setting. The circuit is encapsulated in synthetic resin with the exception of the crystal, which is replaceable.

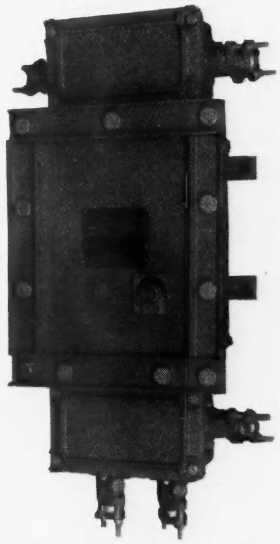
Two types of crystal may be used: one having a zero temperature coefficient between 15 and 20 deg C and the other a zero temperature coefficient between 40 and 50 deg C. The stability of the oscillator at or about the point where the zero temperature coefficient occurs is of the order of three parts in 10^6. The supply voltage is nominally 10 V but the oscillator will function satisfactorily at 4 to 12 V. The square wave output is about 7·5 V peak-to-peak with a 10 V supply, the corresponding sinusoidal output being 5·6 V peak-to-peak. A low impedance output is provided for the square wave via an emitter follower and provision is made for gating.

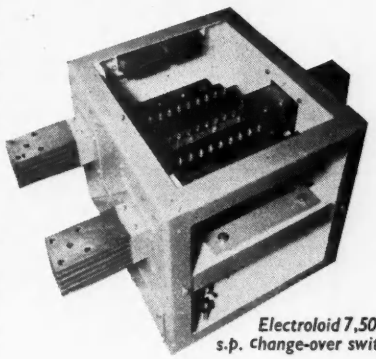


"Meetap" production analyser



Venner transistorised crystal oscillator


E.A.C. flameproof relay panel


Electroloid 7,500A s.p. change-over switch

Heavy Current L.V. Switchgear

A new range of switchgear manufactured by ELECTROLOID, LTD., Cricklewood, London, with ratings from 50 A to 1,000 A at voltages up to 24 V, suitable for such applications as electroplating and refining, d.c. furnace switching and battery charging. These switches are solenoid operated and any switch arrangement can be provided. They can be operated remotely by push-button and being totally enclosed they are not subject to corrosion.

This switchgear can be mounted in the busbar run, obviating the necessity for bringing expensive runs of copper down to ground level.

Flameproof Relay Panel

The 1955 N.C.B. (Production) Codes and Rules governing underground compressors of the reciprocating type stipulate that in addition to providing protection on both low and high pressure outlets of dual-stage machines the installation of an audible warning device is necessary. To comply with this requirement a special flameproof relay panel has been designed by the ELECTRICAL APPARATUS CO., LTD., New Barnes, St. Albans, Herts. It is intended for use in conjunction with one or two E.A.C. thermostats and it derives its supply from the normal 110 V single-phase lighting supply. A 110/15 V step-down transformer is embodied in the panel to feed an external intrinsically safe alarm circuit.

Installations already employing E.A.C. thermostats would merely require a slight alteration to be made to their external wiring, the connections from the thermostat(s) and motor "stop" circuits being fed directly to the relay panel.

In the event of operation of the thermostat(s) inserted in the air outlet of the compressor, the relay would open, shutting down the compressor and actuating the alarm which would continue to sound until the relay was reset by means of its push-button.

Financial Section

STOCKS and SHARES

INFLUENCED mainly by the course of events in the engineering wages negotiations, Stock Exchange markets had made good, by the beginning of this week, the great part of the previous recession. Government securities reflected a recovery in the sterling exchange rates. In the industrial market the revival was a good deal livelier: comment on the latest developments was inclined to favour ordinary shares because of the inflationary implications of the situation. The latter are being taken into consideration also in connection with the Budget due to be opened on Tuesday week, 9th April, and now the main factor in the early market outlook. Even without the prospect of another widespread rise in the level of wages, and hence perhaps of prices too, expectations had not been entertaining any extravagant ideas of tax remissions.

General Recovery

With the final dividend declarations immediately ahead, the shares of A. Reyrolle and C. A. Parsons took a lead in the active recovery with which the market in electrical engineering shares began this week. In rising respectively to 110s and 70s, both recorded easily the best quotations of the year. Most of the other shares in the principal nuclear power groups went at least a long way towards erasing the setbacks of the week before. A.E.I., English Electric and G.E.C. showed recoveries of between 1s 3d and 2s 6d. Babcock & Wilcox returned particularly well to favour, reaching 80s, and Richardsons Westgarth were active at around 18s on news of the company's plans for further expansion through the offer for the shares of Parsons Marine Turbine. Tube Investments jumped 4s to 61s 6d after the announcement that the company's fresh capital requirements are to be raised through a loan stock. Hoover resumed their advance, and radio shares improved, with Thorn Electrical prominent at 20s. Plessey rose to 76s.

Wolf Electric Results

Financial results announced by Wolf Electric Tools (Holdings) were good enough to lift the price of the 5s shares by 2s to 19s 6d. Group profits for 1956 are up by about £11,000 to £151,000, of which fully three-quarters is being retained in the business. The dividend is being maintained at 20 per cent for the third year running, and a one-for-one scrip issue is proposed. These results are the outcome of what the chairman said, in the last report, would be a testing year for the business, affected as it was by mounting competition, especially overseas, and by the credit restrictions. Now at their best price of the year, the shares show a yield of 5·1 per cent on the well-covered dividend.

Switchgear & Cowans

The final dividend of 15 per cent to be paid by Switchgear & Cowans for 1956 is the rate forecast at the time of

Price Changes in

Company or Board	Nom. Value	Middle price 25th Mar.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	77½		3	3	3 17 6	80	75
Brit. Elec. 1974/77	100	75½		3	3	3 19 6	78¼	73½
Brit. Elec. 1976/79	100	80½		3½	3½	4 7 0	81½	77¼
Brit. Elec. 1974/79	100	89½	—1	4¼	4¼	4 15 0	92½	87¼
Overseas Electric Supply								
Calcutta Elec.	£1	18/6		6†	6†	6 9 9†	19/-	18/3
East African Power	£1	20/-		7	7	7 0 0	20/6	19/3
Nigerian Elec.	£1	17/6		10	10*	11 8 6	18/6	17/3
Perak Hydro-Elec.	£1	14/9		10	10*	13 11 3	14/9	13/3
Equipment and Manufacturing								
Aberdare Cables	5/-	10/6	—6d	17½	17½	8 6 9	11/3	9/9
Aerialite	1/-	5/6	—3d	45	48	8 14 6	6/-	4/9
Allen, W. H.	£1	40/-		20	10*	5 0 0	40/-	33/6
Aron Elec. Ord.	£1	56/3		15	15	5 6 9	55/6	53/6
Assd. Automation	10/-	19/6		10	5	2 11 3	20/9	17/9
Assoc. Elec. Ord.	£1	63/9	+1/3	15	15	4 14 0	73/-	62/6
Automatic Tel. & El.	£1	60/-	+2/6	15	15	5 0 0	60/-	54/6
Babcock & Wilcox	£1	80/-	+3/9	15	15	3 15 0	82/6	71/6
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	4/-
Bakelite	10/-	21/9	+1/3	16	15	6 18 0	21/9	20/9
Berry's Electric	5/-	5/9		—	10‡	8 14 0	5/9	5/6
British Aluminium	£1	67/6		12	12	3 11 0	70/6	63/9
B.I. Callender's	£1	50/3	+9d	10	12½	4 19 6	51/6	48/3
B.I. Callender's 6% Pref.	£1	21/9		6	6	5 10 3	21/9	20/6
British Tabulating	£1	50/-	+6d	9	9	3 12 0	50/-	42/-
British Thermostat	5/-	27/-		20	25	4 12 6	27/6	25/9
British Vac. Cleaner	5/-	6/9	—3d	30	15*	11 2 3	8/-	6/6
Brook Motors	10/-	31/3		25	25	8 0 0	33/3	30/-
Brush Group	5/-	5/-	+3d	10	Nil	Nil	6/3	4/6
Bulgin, A. F.	1/-	5/-	—3d	50	40*	8 0 0	5/6	4/6
Burco Dean	5/-	11/-		22½	20	9 1 9	11/3	8/9
Chloride El. Storage "A"	£1	66/3		17½	17½	5 5 9	68/-	58/-
Clarke Chapman	£1	145/-		22½	27½	3 15 9	7¼	6¼
Cole, E. K.	5/-	19/3	+9d	17½	17½	4 11 0	19/6	16/6
Cossor, A. C.	5/-	6/3		15	Nil	Nil	7/3	5/9
Crabtree	10/-	24/6	—6d	20	20	8 3 3	25/6	23/3
Crompton Parkinson Ord.	5/-	16/3		16	16	4 18 6	17/9	14/6
De La Rue	5/-	17/6	—6d	30	30	8 11 6	19/9	16/3
Decca "A"	4/-	27/6		43¾	43¾	6 7 3	32/3	27/-
Desoutter	5/-	29/6		30	32½	5 10 3	29/-	27/6
Dewhurst	2/-	6/6	3d	30	16¼*	5 0 0	7/6	5/9
Dictograph Tel.	2/-	7/-	—6d	20	20	5 14 3	7/6	6/9
Dubilier Condenser	1/-	5/3		25	30	5 14 3	5/9	5/6
Duport	5/-	18/9		23	25	6 13 3	19/6	17/6
E.M.I.	10/-	29/6	+9d	15	15	5 1 9	29/6	23/9
Electrical Components	5/-	7/3		25	25	8 12 6*	7/3	6/6
Elec. Construction	£1	25/-		8½	8½	6 16 0	25/6	21/9
Elliott Bros.	5/-	27/6		17½	20‡	3 12 9	29/-	26/3
Enfield Cable Ord.	£1	16/3		Nil	Nil	Nil	21/6	13/-
English Electric	£1	57/6	+1/3	12½	14	4 17 6	58/9	47/6
English Electric 3½% Pref.	£1	13/-	—6d	3¾	3¾	5 15 6	14/3	13/-
Ericsson Tel.	5/-	39/-	+1/-	20†	22†	2 16 6†	41/-	33/3
Ever Ready	5/-	30/9		35	35	5 13 9	31/9	30/-
Falk Stadelmann	£1	38/6		17½	17½	9 1 9	38/6	35/-
G.E.C. Ord.	£1	56/3	+2/6	12½	14	4 19 9	57/9	48/9
G.E.C. 6½% Pref.	£1	22/6	—6d	6½	6½	5 15 6	23/6	22/-
General Cables	5/-	12/9	+6d	30	30	11 15 3	13/6	11/6
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	46/3	45/3
Hackbridge Holdings	5/-	20/3	+6d	25	30	7 8 3	21/-	19/9
Hackbridge & Hewittic	5/-	15/-		30	23*	7 13 3	16/-	13/6
Heatrae	2/-	4/-		15	15	7 10 0	4/-	4/-
Henley's	10/-	16/9		10½	11½	6 17 3	17/-	15/3
Holophane	5/-	23/-		30	30	6 10 6	26/3	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

last October's issue of 200,000 new shares, which qualify for this payment. Also in accordance with expectations then, the profit for the year has been satisfactorily maintained: the net surplus of £54,600 is within £1,500 of the previous figure, after the deduction of some £9,000 more under the headings of depreciation and taxation. With the interim dividend paid before the capital issue, the distribution for the year totals 25 per cent, a rate covered approximately 1¾ times by the earnings available. At a price of 14s 9d for the 5s shares there is a yield of about 8½ per cent on the basis of the 25 per cent payment.

Electrical Investments

Company or Board	Nom. Value	Middle price 25th Mar.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	35/6	+2/6	50	50	7 0 9	35/6	24/9
I.C.I.	£1	41/9	+1/3	10	10	4 15 9	43/9	37/9
Intl. Combustion	5/-	25/-		20	22½	4 10 0	25/-	20/-
Johnson & Phillips	£1	29/3	+6d	15	15	10 5 0	34/6	28/6
Lancashire Dynamo	£1	42/6		15	11*	5 3 6	45/-	36/9
Laurence, Scott	5/-	17/9	+6d	12½	15	4 4 6	17/9	13/9
Lister, R. A.	£1	29/3	+6d	9·3	10	6 16 9	30/6	26/9
London Elec. Wire	£1	52/-	—1/-	12½	12½	4 16 3	53/-	43/-
Lucas, J.	£1	32/6		7½	7½	4 12 3	33/9	30/6
Marryat & Scott	2/-	9/3		30	30	6 9 9	9/6	8/-
Mather & Platt	£1	55/6	—6d	15	15	5 8 0	56/-	51/3
Metal Industries	£1	23/-	—9d	9	Nil	—	25/-	20/3
Midland Elec. Mfg.	£1	47/6		12½	12½	5 5 3	47/6	45/-
Morphy-Richards	4/-	13/9		50	50	5 16 3*	14/-	11/9
Murex	£1	70/6	+1/6	20	20	5 13 6	71/6	65/-
Newman Ind.	2/-	2/6		10	10	8 0 0	2/6	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	2/6	2/3
Parnall (Yate)	5/-	7/6		14	12	8 0 0	8/-	5/9
Parsons, C. A.	£1	70/-	+6/3	10	10	—	70/-	50/6
Plessey	10/-	76/-	+3/6	27½	30	3 19 0	76/3	61/-
Pye "A" Deferred	5/-	17/6	+9d	12½	12½	3 11 6	18/3	15/9
Reyrolle	£1	110/-	+5/-	15	16½	2 19 0	110/-	90/-
Rheostatic	4/-	10/-		18½	12½	5 0 0	10/-	8/9
Richardsons Westgarth	5/-	18/-	+3d	16⅔	16⅔	4 12 6	19/-	17/-
Scottish Cables	4/-	18/3		27½	27½	6 0 6	19/3	15/-
Smith (England), S.	4/-	14/6		17½	17½	4 16 6	14/6	13/-
Southern Areas	£1	17/6		10	7½	8 11 6	20/-	13/9
Strand Elec.	5/-	7/6	—3d	15	15	10 0 0	8/-	7/3
Sturtevant	5/-	25/6	—6d	14·4†	15†	2 18 9†	26/-	24/3
Sun Elec.	£1	43/9		20	25	11 8 6	43/9	43/9
Switchgear & Cowans	5/-	14/9	—3d	20	25	8 9 6	15/6	13/6
Taylor Tunnicliff	5/-	12/9	—3d	15	15	5 17 9	13/9	11/9
T.C.C.	10/-	38/9		25	25	6 9 0	38/9	35/-
T.C. & M.	£1	29/6		8½	8½	5 15 3	31/-	24/6
Telephone Mfg.	5/-	7/-	+3d	10	10*	7 2 9	7/-	6/3
Thorn Elec.	5/-	20/-	+1/3	15	15	3 15 0	20/-	16/3
Thornycroft	£1	37/6	+2/6	15	12½	6 13 3	37/6	32/9
Tube Investments	£1	61/6	+4/-	22½	15*‡	4 17 6	62/-	58/3
Vactric	5/-	15/6	+6d	15	17½*	5 13 0	15/6	12/9
Veritys	5/-	8/3	—6d	12½	12½	7 11 6	9/3	8/3
Walsall Conduits	4/-	13/3		70	20*	6 0 9	13/3	11/-
Ward & Goldstone	5/-	43/3		30	35	4 1 0	43/3	36/9
Watford	2/-	6/6		25	25	7 13 9	6/6	6/3
Westinghouse	£1	81/3	+1/3	18	18	4 8 9	82/6	72/-
West, Allen	5/-	13/6	+3d	15	15	5 11 0	14/3	12/3
Wolf Electric	5/-	19/6	+2/-	20	20	5 2 6	19/6	17/3
Trusts, Transport and Communications								
Anglo-Portuguese	£1	23/9		8	8	6 14 9	23/9	20/6
Brit. Elec. Traction: Def. Ord. "A"	5/-	20/6		22½	22½	5 9 9	20/9	17/-
Cable & Wireless: Ord.	5/-	11/-		10	10	4 11 0	12/-	9/6
4% Loan	100	92½		4	4	4 6 6	92½	89
Calcutta Trams	£1	25/9		75†	8½†	6 12 0†	26/6	22/9
Cape Elec. Trams	£1	15/6		8	8	10 6 6	15/9	14/6
Marconi Marine	£1	33/6		10	10	5 19 6	33/6	31/-
Oriental Tel. Ord.	1/-	74/6		16	—	—	77/6	66/6
Telephone Rentals	5/-	11/-		12½	12½	5 13 9	11/3	10/3

Aberdare Cables

In maintaining the dividend for 1955–56 at a total of 17½ per cent for the third successive year, Aberdare Cables (Holdings) report a net profit of £253,000. This is lower than before, but a large part of the reduction is accounted for by an increase in the charge for taxation. It provides practically two-fold cover for the amount distributed in the dividend. Last year's report mentioned the strength of competition in the industry and the effects of the credit squeeze through the restraints on capital expenditure by the nationalised industries. After easing to 10s 6d, the 5s ordinary shares are on a yield basis of over 8¼ per cent.

April Dividends

In the coming month a constant flow of final dividend declarations and company profits statements for 1956 can be expected to be maintained. A. Reyrolle's results were due to be published yesterday (Thursday). Those of C. A. Parsons usually appear at about the same time. Special interest attends the announcements on this occasion, since in both cases the final payments apply to capital greatly increased by the issues made a few months ago. News will be due soon from most of the cable and telephone manufacturing companies. Last year, the Telegraph Construction and B.I.C.C. results came first, followed in the second half of April by Johnson & Phillips, Automatic Telephone, L.E.W. and Enfield. Other companies from which statements are due within the next few weeks include Allen West, Lancashire Dynamo, Laurence Scott, Babcock & Wilcox, Newman Industries and Elliott Brothers.

New Issues

An issue of £7½ million loan stock to the shareholders of Tube Investments will shortly bring into the market another industrial security giving the holder a return in the neighbourhood of 5½ per cent, with first-grade security, and transferable without the expense of the 2 per cent stamp duty in initial dealings. This 5¼ per cent stock, redeemable at 100 between 1977–82, is being offered at a price of 95½. Application lists are to close next Friday (5th April) and public dealings can be expected to start a few days later. One of the principal objects of the issue is to finance the recent acquisition of new iron and steel subsidiaries, and to provide for their development and modernisation. Another issue will appear next month from the Electric Construction Co., who are offering to their shareholders a £500,000 convertible loan stock. Dealings began in R. B. Pullin new 2s shares at a premium of about 2s 3d on the issue price of 5s.

REPORTS and DIVIDENDS

The Brush Group, Ltd.—The group accounts for the year ended 28th December last show that sales of products amounted to £22,488,981, as compared with £22,094,389 for the preceding year, and after deducting cost of goods sold, including all expenses of production, selling and administration, there was a profit of £1,878,104 (against £2,339,959). After providing for depreciation, etc. (£762,145), bank, mortgage and other interest (£628,486), and taxation of £347,048, there is a net balance of £174,101 (against £479,836), to which is added taxation provision for previous years no longer required of £12,213. The net profit attributable to the parent company is £180,769 (£531,082). General reserve receives £100,000. No dividend is proposed on the ordinary capital (against 10 per cent), and the balance carried forward is £333,723 (against £321,663 brought in). It is stated that deliveries fell short of expectations and costs, including wages, salaries and materials, increased sharply. In addition there was a heavy increase in bank charges.

Mather & Platt, Ltd.—In the course of his speech at the annual meeting held on 21st March, Mr. L. E. Mather (chairman) said that the overseas business had shown in the main gratifying results. More and more, however, they were having to consider the establishment of subsidiary companies, not only to meet fiscal requirements of countries where they had previously worked through branches or agents, but also to make use of more local materials for the purposes of assembly and in some cases for complete manufacture. They had an adequate volume of unexecuted orders on the books to carry out during the current year.

The Westinghouse Brake & Signal Co., Ltd.—Preliminary details have been announced of the scrip and rights issues referred to by the chairman in his recent annual statement.

It is proposed to capitalise £2,666,034 of share premium account to provide a one-for-one scrip issue to ordinary shareholders. The new shares will rank for the full amount of all dividends declared for the current year. It is also proposed to offer by way of rights 1,777,356 ordinary £1 shares on a two-for-three basis. Treasury consent has been received to both issues and the proposals will be submitted to an extraordinary meeting to be held on 15th April.

Tube Investments, Ltd.—Helbert Wagg & Co. and J. Henry Schroder & Co. announce that underwriting has been completed on behalf of Tube Investments, Ltd., for the offer to preference and ordinary stockholders of £7½ million 5¼ per cent unsecured loan stock, 1977-82, at £95½ per cent. The proceeds will be applied towards replacing sums already paid and to repaying the balance of £4·6 million owing to the Iron and Steel Holding and Realisation Agency in respect of the recent purchases of Park Gate Iron & Steel Co. and Renishaw Iron Co. and the half interest in Byfield Ironstone Co., and to provide for the cost of expansion and modernisation schemes in hand for these companies.

The Electric Construction Co., Ltd.—Underwriting has been completed by W. Greenwell & Co., for the issue of £500,000 convertible unsecured loan stock. The stock will carry 5¼ per cent interest and is redeemable 1972-77. It is being offered to preference and ordinary shareholders at 99 per cent. The conversion right is of £50 stock into 36 £1 ordinary shares on 1st September in the years 1958, 1959 and 1960.

Switchgear & Cowans, Ltd., report a revenue balance for 1956, including results of subsidiaries, of £222,520, as compared with £213,975 for 1955, and after meeting all charges, including £86,725 for taxation, the net profit is £54,604 (against £56,098). General reserve receives £20,000 and it is proposed to pay a final dividend of 15 per cent, making 25 per cent for the year. The shares issued in the two-for-seven rights issue rank for the final dividend. For the previous year the distribution was also 25 per cent on the old capital. The balance carried forward is £112,060 (against £106,925 brought in).

Aberdare Cables (Holdings), Ltd.—The preliminary statement for 1956 shows a group net profit, after providing £337,575 for taxation, of £253,113, as compared with £317,780 for the preceding year. The dividend for the year is maintained at 17½ per cent with a final payment of 10 per cent. The balance carried forward is £563,782 (against £441,447 brought in).

Sangamo Weston, Ltd.—The trading profit for 1956 amounted to £457,252, as compared with £522,809 for the preceding year, and after providing for depreciation, and taxation of £170,995, there is a net balance of £203,512 (against £231,760). General reserve receives £131,154 and it is proposed to maintain the dividend for the year at 12½ per cent. The balance carried forward is £185,972 (against £164,555 brought in).

Wolf Electric Tools (Holdings), Ltd.—The accounts for 1956 show a group net profit of £151,071, as compared with £140,158 for the previous year. Taxation charged was £153,946. The dividend for the year is unchanged at 20 per cent. Subject to the consent of the Capital Issues Committee it is proposed to capitalise £318,395 of reserves in making a 100 per cent scrip issue to ordinary shareholders, and it is also proposed to increase the authorised capital to £1,060,000. The new shares will not rank for the dividend now declared.

Brown Brothers, Ltd.—The group net profit for 1956 was £328,923, after charging £456,044 for taxation. This compares with a net balance of £431,717 for 1955. It is proposed to pay a final dividend of 10 per cent, making 12½ per cent for the year on the ordinary capital, against an equivalent of 11⅔ per cent for 1955, when an interim dividend of 2½ per cent was paid on capital before a 50 per cent scrip issue.

The Nigerian Electricity Supply Corporation, Ltd., has declared an interim dividend of 4 per cent (unchanged).

Taylor, Tunnicliff (Electrical Industries), Ltd.—In our summary of Sir John Kent's annual review in our last issue we incorrectly stated that Mr. J. V. Cooper is to succeed him as chairman of the company after the annual meeting on 2nd April. The company informs us that the new chairman will be Mr. Percy Cooper.

Increase of Capital

Dale Electric (Yorkshire), Ltd.—Increased by £40,000, in 18,000 7½ per cent cumulative redeemable preference, 494 7½ per cent cumulative preference and 21,506 ordinary shares of £1 each, beyond the registered capital of £10,000.

New Companies

A. T. Snowden (Branches), Ltd.—Registered 25th February. Capital £2,000. Radio, television, electrical, telecommunication and mechanical engineers, retailers, wholesalers, contractors and manufacturers, etc. Directors: K. F. Jackson, R. A. K. Coe and H. M. Henshell. Regd. office: 171, Dunstable Road, Luton.

Ryans (Castleford), Ltd.—Registered 25th February. Capital £5,000. Factors, distributors, merchants of and dealers for cash or on credit on hire purchase in television and radio receivers, etc. Directors: H. Ryans and Mrs. Mary Ryans. Regd. office: 15, Church Street, Castleford, Yorks.

Hessings Radio, Ltd.—Registered 15th February. Capital £5,000. Manufacturers of and dealers in and repairers of and hirers of electrical and mechanical apparatus of all kinds, in particular wireless sets, etc. Directors: Georgina Bednell, Pamela M. Hessing and L. W. Bednell. Regd. office: 11, Tatchbrook Road, Leamington Spa, Warwicks.

Liquidations

James R. Thomson & Co., Ltd., plumbers' merchants, hardware and electrical wholesalers—Winding up voluntarily. Liquidator, Mr. T. P. H. Brown, 29, Waterloo Street, Glasgow, appointed 8th March. Particulars of claims to the liquidator by 31st March. (This notice is formal. All creditors have been or will be paid in full.)

Radio Construction & Maintenance, Ltd.—Winding up voluntarily. Liquidator, Mr. G. L. Chick, 32, Churchill Way, Cardiff, Glam.

Bankruptcy

G. Dickinson and **K. G. Dickinson**, carrying on business in partnership as G. & K. G. Dickinson at 134, Clipsley Lane, and 321, Church Road, Haydock, Lancs, electricians.—Receiving order made 4th March on a creditor's petition. Public examination 30th April at the Court House, India Buildings, Water Street, Liverpool, 2.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 3rd April from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

14231. Benjamin Electric, Ltd., and Campbell, G.—Lighting fittings for elongated electric lamps. 22nd May, 1953. (771471.)

15804. General Electric Co., Ltd., and Cates, J.—Electric lighting fittings for the operation of electric-discharge lamps. 16th June, 1953. (771591.)

19122. Standard Telephones & Cables, Ltd.—Ionisation manometers. 29th July, 1952. (Addition to 678695.) (771799.)

25364. National Research Development Corporation.—Waveform shaping stages. 1st October, 1953. (771592.)

27908. Licentia Patent-Verwaltungs-Ges. —Magnetic voltage stabiliser. 5th November, 1952. (771472.)

31533. General Electric Co., Ltd., Chubb, A. A., and Elliott, D. S.—Photographic camera and lighting assembly. 24th November, 1953. (771805.)

1953

15512. Electric & Musical Industries, Ltd.—Terminations for ultra-high-frequency transmission lines. 4th June, 1954. (771353.)

17135. Semtex, Ltd.—Electrically conductive reinforced polyester resin compositions. 15th June, 1954. (771559.)

19110. Sylvania Electric Products, Inc.— Electroluminescent lamp. 9th July, 1953. (771356.)

19228. Standard Telephones & Cables, Ltd.—Receiving channel amplifier and signal receiver. 10th July, 1953. (771594.)

22522. M-O Valve Co., Ltd.—Electric travelling-wave amplifiers. 9th August, 1954. (771673.)

26260. Simms Motor Units, Ltd., and Rackham, G. J.—Dynamo rotary pump combinations. 13th June, 1955. (771595.)

26756. British Thomson-Houston Co., Ltd.—Transistors. 17th September, 1954. (771443.)

27773. Walsall Conduits, Ltd.—Mercury and other conducting liquid switches. 11th October, 1954. (771475.)

29951. British Thomson-Houston Co., Ltd.—Electric lamps and bases therefor. 29th October, 1953. (771476.)

31553. Metropolitan-Vickers Electrical Co., Ltd.—Trigger circuits for electric discharge devices. 2nd December, 1954. (771596.)

33190. General Electric Co., Ltd., and Parton, K. C.—Magnetic amplifiers. 25th November, 1954. (771479.)

33845. Central Electricity Authority, and Hasler, E. F.—Electric potential transforming apparatus. 29th December, 1954. (771674.)

35696. General Electric Co., Ltd., and Lambert, R. A.—Radiographic apparatus. 1st December, 1954. (771675.)

1954

3117. Hunt (Capacitors), Ltd., A. H.— Sealing of containers for electrical components. 26th January, 1955. (771445.)

3798. General Electric Co., Ltd., and Bloch, A.—Telephone subscribers' apparatus. 9th May, 1955. (771885.)

3852. Linolite, Ltd.—Electric lampholders. 9th May, 1955. (771760.)

3929. British Insulated Callender's Cables, Ltd.—Apparatus for marking wires and cables and the like. 9th February, 1955. (771830.)

4173. Schmid, W. K.—Electric tracer control systems for manufacturing machines. 12th February, 1954. (771680.)

4220. British Thomson-Houston Co., Ltd.—Circuit arrangements supplying electric arcs. 7th February, 1955. (771534.)

5164. Crompton Parkinson, Ltd.—Electric light fittings. 14th February, 1955. (771535.)

6090. Philips Electrical Industries, Ltd. —Circuit arrangements for regulating. 2nd March, 1954. (771363.)

6120. General Electric Co.—Measuring instruments. 2nd March, 1954. (771480.)

6990. Pye, Ltd.—Temperature-controlled oven assembly. 6th April, 1955. (771365.)

7064. Automatic Telephone & Electric Co., Ltd.—Change-over circuit arrangements. 4th February, 1955. (Addition to 765928.) (771481.)

7131. General Electric Co., Ltd.— Arrangements for modulating electric carrier wave oscillations. 4th March, 1955. (771366.)

9840. Electric & Musical Industries, Ltd. —Generation of colour television signals. 24th March, 1955. (771536.)

10087. British Insulated Callender's Cables, Ltd.—Method and apparatus for forming collars on the ends of thermoplastic tubes. 6th April, 1955. (771368.)

11529. Automatic Electric Laboratories, Inc.—Single motion numerical switch. 21st April, 1954. (771793.)

12883. Ferranti, Ltd.—TR cells. 4th May, 1955. (771369.)

13129. Marconi's Wireless Telegraph Co., Ltd.—High frequency phase comparators. 15th April, 1955. (771684.)

13602. Meritus (Barnet), Ltd.—Electrical impedance testing instruments. 9th May, 1955. (771537.)

14517. Oehman, P. V.—Process for anodic esterification. 18th May, 1954. (771568.)

14652. Automatic Telephone & Electric Co., Ltd.—Telephone systems. 5th May, 1955. (771485.)

14763. Babcock & Wilcox, Ltd.—Vapour generating and superheating units and a method of operation thereof. 18th May, 1955. (771888.)

14834. Mullard Radio Valve Co., Ltd.— Circuit arrangements for producing a d.c. voltage. 29th April, 1955. (Cognate application 17225, 11th June, 1954.) (771451.)

15294. Abbey, A. (American Optical Co.). —Cathode-ray tubes. 24th May, 1954. (771452.)

16056. Igranic Electric Co., Ltd.—Automatic control systems for Ward-Leonard generators. 31st May, 1954. (771604.)

17479. Mullard Radio Valve Co., Ltd.— Protection circuits for cathode-ray tubes and the like. 14th June, 1954. (771454.)

18260. Westinghouse Brake & Signal Co., Ltd., Peter, L. H., Langridge, A., and Gumm, B. J.—A.c. rectifiers. 24th May, 1955. (771456.)

18599. Rolls-Royce, Ltd.—Electrical ignition systems of gas-turbine engines. 17th June, 1955. (Addition to 697953.) (771890.)

19017. Magnetic Metals Co.—Magnetic shields for cathode-ray tubes. 29th June, 1954. (771891.)

19574. Herterich, W.—Control device adjustable by means of a photo-electric cell and a moving coil system. 5th July, 1954. (771490.)

19762. Landis & Gyr Akt.-Ges.—Method of and meter for determining the apparent power or apparent energy consumption in a balanced polyphase system. 6th July, 1954. (771491.)

20223-4. Microcell, Ltd., Travers, R. S., and Kremer, H.—Electrical delay circuits. 10th October, 1955. (771372-3.)

22346. Limit Engineering Group, Ltd.— Rotary fans, particularly electric fans. 25th July, 1955. (Cognate application 9789, 4th April, 1955.) (771894.)

22495. Pyrotenax, Ltd.—Electric cable mounting devices. 3rd August, 1955. (771610.)

22845. Yoshida, T.—Process for the electrodeposition of iron-chromium alloy. 5th August, 1954. (771695.)

24519. General Electric Co., Ltd., and Bloch, A.—Telephone subscribers' apparatus. 23rd August, 1955. (771494.)

25752. Allday & Son (1922), Ltd., H.— Electric tumbler switches. 31st August, 1955. (771377.)

25931. Metropolitan-Vickers Electrical Co., Ltd.—Electrical pulse generators. 24th August, 1955. (771696.)

26174. Crosfield, Ltd., J. F.—Electrical production of printing surfaces. 2nd September, 1955. (Cognate application 1534, 18th January, 1955.) (771542.)

27590. Compagnie des Machines Bull.— Electronic means for carrying out algebraic calculations. 23rd September, 1954. (771764.)

29280. General Aniline & Film Corporation.—Electrical charge transfer system. 11th October, 1954. (771459.)

29398. Aktiebolaget Tudor. — Electric storage battery plates. 12th October, 1954. (771496.)

32420. Scholl, G.—Electric welding. 9th November, 1954. (771545.)

32462. Siemens & Halske Akt.-Ges.— Supervisory circuit arrangement for axle counters in railway safety systems. 9th November, 1954. (771498.)

32845. General Electric Co.—Transparent luminescent films. 12th November, 1954. (771460.)

35234. Marie, G. R. P.—Dispersion devices for centimetric and millimetric electromagnetic wave energy. 6th December, 1954. (771621.)

36476. Bristol Co.—Electronic control circuits. 16th December, 1954. (771384.)

37029. International Business Machines Corporation.—Electric-charge storage apparatus. 22nd December, 1954. (771625.)

1955

575. Murphy Radio, Ltd.—Inductance coils. 9th January, 1956. (771701.)

883. Rodale Mfg. Co., Inc.—Electrical connectors. 11th January, 1955. (771386.)

2495. Philips Electrical Industries, Ltd. —Housing enclosing a plurality of electric contacts adapted to co-operate with the contacts of a removable electrical appliance, for example a lamp or plug. 27th January, 1955. (771547.)

2928. Olivetti & C. Soc. per Azioni Ing., C.—Electric pulse counting and calculating apparatus. 1st February, 1955. (Addition to 731140.) (771463.) 2929. Digital computing apparatus. 1st February, 1955. (771388.)

3178. Standard Telephones & Cables, Ltd.—Electrical h.f. waveguide device. 3rd February, 1955. (771389.)

5138. Radio Corporation of America.— Photoelectric cathode. 21st February, 1955. (771504.)

7246. Aktiebolaget Tudor.—Separators for secondary cells. 11th March, 1955. (771393.)

7697. Siemens & Halske Akt.-Ges.— Magnetically controlled electronic valves. 16th March, 1955. (771550.)

7700. Deutsche Edelstahlwerke Akt.-Ges. —Apparatus for heating electrically conductive bodies. 16th March, 1955. (771395.)

8855. Standard Telephones & Cables, Ltd.—Control circuit for cathode-ray tube. 25th March, 1955. (771509.)

[*Continued on next page*

NEW PATENTS (*continued*)

9161. General Electric Co.—Electrical contact material and methods of making it. 29th March, 1955. (771705.)

9590. General Electric Co.—Silicone water-repellent compositions. 1st April, 1955. (771844.)

9603. Automatic Electric Laboratories, Inc.—Impulse storage unit. 1st April, 1955. (771464.)

10699. Allis-Chalmers Manufacturing Co.—Dynamo-electric machine with gas jet cooled lead conductors and terminal bushings. 13th April, 1955. (771770.) 28677. Dynamo-electric machine with bare collector leads. 7th October, 1955. (771819.) 35506. Synchronous induction motor having a segmented rotor and squirrel cage winding. 9th December, 1955. (771669.)

13163. Detroit Coil Co.—Oil bath solenoid. 6th May, 1955. (771404.)

15338. Commissariat a l'Energie Atomique.—Manufacture of Geiger-Müller counters containing a halogen vapour. 27th May, 1955. (771707.)

16470. Lewit Corporation.—Vacuum cleaners. 8th June, 1955. (771410.)

16940. Kritz, J.—Continuously indicating electro-acoustic densitometer. 13th June, 1955. (771637.)

18047. Minnesota Mining & Manufacturing Co.—Methods and apparatus for magnetically recording and reproducing electrical signals. 22nd June, 1955. (771412.)

19782. Westinghouse Electric International Co.—Food waste disposer apparatus. 8th July, 1955. (771419.)

19811. Rush, S. H.—Bakers' electric ovens. 8th July, 1955. (771774.)

20821. Leicht, A. A. (trading as Eltra Komm.-Ges. Leicht & Trambauer).—Electrical heater for railway points. 19th July, 1955. (771722.)

20903. Moser-Glaser & Co., Akt.-Ges.—Construction of high tension dynamo-electric machines. 19th July, 1955. (771724.)

21415. Electric Storage Battery Co.—Electric storage battery plates. 25th July, 1955. (771727.)

21806. Triggs, W. W. (Kohlagen, W.).—Reaction type synchronous motor with permanent magnet rotor. 28th July, 1955. (771732.)

22308. E.M.B. Elektromotorenbau Akt.-Ges.—D.c. exciter units for synchronous alternators. 3rd August, 1955. (771737.)

22948. British Thomson-Houston Co., Ltd.—High voltage current transformers. 9th August, 1955. (Addition to 739497.) (771739.)

23167. Westinghouse Electric International Co.—Insulated electrical conductors. 11th August, 1955. (771864.)

23318. General Electric Co.—Dynamo-electric machines. 12th August, 1955. (771645.) 26604/6. Thermal protection of single-phase a.c. motors. 16th September, 1955. (771873-4.) 26608. Slot wedges for dynamo-electric machines. 16th September, 1955. (771654.) 30657. Frame of dynamo-electric machines. 26th October, 1955. (771665.) 31493. Resilient mountings for rotating machines. 3rd November, 1955. (771666.)

23913. Westinghouse Electric International Co.—Bushings for electrical apparatus. 19th August, 1955. (771744.)

24891. Aktieselskapet per Kure Norsk Motor- og Dynamofabrik.—Electric transformer or similar cores. 30th August, 1955. (771652.)

26557. Fernseh Ges.—Supply arrangements for electric motors. 16th September, 1955. (771872.)

26690. Westinghouse Electric International Co.—Electric control systems for energising a polyphase a.c. load. 19th September, 1955. (771589.)

27324. United States Rubber Co.—Portable electric cord. 26th September, 1955. (771656.)

28521. Collins Radio Co.—Variable inductors. 6th October, 1955. (771661.)

28743. Pfaff Akt.-Ges., G. M.—Control of electric sewing and like machines. 10th October, 1955. (771820.)

29722. Automatic Electric Laboratories, Inc.—Telephone system. 21st April, 1954. (Divided out of 711793.) (771794.)

30399. Naamlooze Vennootschap Philips' Gloeilampenfabriken.—Timepiece mechanisms. 24th October, 1955. (771823.)

35878. Westinghouse Electric International Co.—Electric toasters. 14th December, 1955. (771878.)

36654. Philips Electrical Industries, Ltd.—Electric coils. 21st December, 1955. (771825.)

37430. Western Electric Co., Inc.—Coaxial transmission lines for high frequency electromagnetic waves. 30th December, 1955. (771670.)

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 6th April :—

KEARFOTT (design). No. 751,259. Class 7. Electric motors (not for land vehicles) and electric generators and parts.—Kearfott Co., Inc., Clifton, N.J., U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5-9, Quality Court, Chancery Lane, W.C.2.

GILFILLAN. No. B746,870. Class 9. Radar apparatus for use in the remote control and location of aircraft.—Gilfillan Bros., Inc., Los Angeles, Cal., U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5-9, Quality Court, Chancery Lane, W.C.2.

MARCONI (design). No. 702,915. Class 9. Radio, telephonic, telegraphic and television transmitting apparatus; apparatus for controlling and producing audio-frequency and video-frequency signals; radio locating, transmitting and receiving apparatus; radio telegraphic, telephonic and television receiving apparatus and relay apparatus for use therewith not being receiving apparatus for use in radio broadcast reception by the public or in public address apparatus; parts of the aforesaid goods; thermionic valves and piezo-electric crystals for all these goods being supplied by the constructors of the aforesaid apparatus either directly or indirectly but not through retail shops to the purchaser or user; and electrical apparatus and instruments for measuring electrical, physical and chemical characteristics and properties and for deriving therefrom indications, records and controls; but not including parts of any of these goods for use in radio broadcast reception by the public or in public address apparatus and not including radio, telephonic, telegraphic and television receiving apparatus and parts for entertainment or educational purposes.—Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, London, W.C.2.

SCANATRON. No. 754,575. Class 9. Electronic apparatus for use in the detection and correction of distortions during multi-colour reproductions by printing or photographic processes and parts.—J. F. Crosfield, Ltd., 2, Elthorne Road, London, N.19.

MAGNASTRIPE (design). No. 754,824. Class 9. Magnetic tape and magnetic film, all for use as sound recording media.—Photographic Electrical Co., Ltd., 71, Dean Street, London, W.1.

LODAR. No. B756,472. Class 9. Echo-sounding apparatus. — Electro - Acustic G.m.b.H., Kiel, Germany. Address for service, c/o Baron & Warren, 16, Kensington Square, London, W.8.

No. 757,649 (design). Class 9. Switches, sockets, combined switches and sockets, plugs and fuses, all being electric; push-buttons for bells; and parts.—Busch-Jaeger Dürener Metallwerke, Akt.-Ges., Westphalia, Germany. Address for service, c/o D. Young & Co., 10, Staple Inn, London, W.C.1.

TRANSPAN. No. 759,192. Class 9. Electrical apparatus and instruments.—Mek-Elek Engineering, Ltd., 17, Western Road, Mitcham, Surrey.

TEFI (design). No. 759,667. Class 9. Sound recording and sound reproducing apparatus and instruments; discs, strips, tapes, wire and film, all for use as sound reproducing media; and radio and television apparatus.—Telfi-Apparatebau Dr. Daniel Kommandit-Gesellschaft, Cologne, Germany. Address for service, c/o Boult, Wade & Tennant, 112, Hatton Garden, London, E.C.1.

SUPERLUX. No. 759,726. Class 9 Electric vacuum cleaning apparatus and parts.—Bylock Electric, Ltd., 109, South Street, Enfield, Middx.

AUTO-REGULAC. No. 760,385. Class 9. Variable voltage transformers, automatic voltage regulators and automatic voltage stabilisers.—Claude Lyons, Ltd., 76, Old Hall Street, Liverpool, 3, and Valley Works, 4-10, Ware Road, Hoddesdon, Herts.

VOHEES. No. 760,452. Class 9. Electric arc welding electrodes.—English Electric Co., Ltd., Queen's House, 28, Kingsway, London, W.C.2.

FLUIDRONIC. No. 760,748. Class 9. Electrical apparatus for measuring variable quantities, for indicating and recording such measurements and for automatically controlling the operation of other apparatus in order to take account of the variations so measured.—Fielden Electronics, Ltd., Paston Road, Wythenshawe, Manchester, 22.

BIRHEAT. No. 761,019. Class 9. Electric soldering irons.—G. K. Lancaster (London), Ltd., 1325, London Road, London, S.W.16.

VAPOZONE. No. 758,834. Class 10. Electrical apparatus for producing and mixing steam and ozone for use in the treatment of the scalp and face.—Osborne, Garrett & Co., Ltd., 51-54, Frith Street, Soho, London, W.1.

INFRADETTE. No. 759,588. Class 10. Electric infra-red heating apparatus for surgical or curative purposes.—Pifco, Ltd., Pifco House, Watling Street, Manchester, 4.

SPOTLINE (design). No. B747,508. Class 11. Adjustable reflectors for fluorescent lamps.—Linolite, Ltd., The Mill Works, Malmesbury, Wilts.

ADAPTALINE. No. 757,593. Class 11. Lighting installations and appliances and lighting apparatus.—A.E.I. Lamp & Lighting Co., Ltd., Crown House, Aldwych, London, W.C.2.

Street Lighting Plans

New street lighting is to be installed in Long Street by **Atherstone (Warwickshire)** R.D.C. at cost of £4,317.

Bedwellty.—Referring to the note in our 15th March issue, Cohen Bros. (Electrical), Ltd., inform us that they were the main contractors for this installation and supplied the "Osram" integral lamps made by the General Electric Co., Ltd.

Chesterfield Works Committee has received the consent of the Ministry of Housing and Local Government to a £4,394 loan for the installation of Group "A" sodium lighting in Brimington Road.

The borough engineer of **Darlington** is to prepare a scheme for Class "B" lighting in a number of thoroughfares.

Sodium lighting is to be installed by **Chesterfield** R.D.C. along Brimington Road, at cost of £4,394.

Cleethorpes Town Council is to proceed with a £3,400 lighting scheme for the promenade.

Sunderland Town Council is being recommended to spend £8,100 for converting street lighting on the Ford estate from gas to electricity.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 1st April

BIRMINGHAM.—James Watt Memorial Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Centre. "The Pimlico District Heating Undertaking—Costs and Financial Results," by B. Donkin, C. M. Johnston and E. Ockenden. (Joint meeting with the South Midland Supply and Utilisation Group.)

BOLTON.—Balmoral Hotel, Bradshawgate, 7.30 p.m. A.S.E.E. Bolton Branch. 1956 Electrical Engineers' Exhibition film.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. "Kopp Variators," by J. A. Horne.

LIVERPOOL.—At the Liverpool Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey and North Wales Centre. "The Potentialities of Railway Electrification at the Standard Frequency," by E. L. E. Wheatcroft and H. H. C. Barton. Annual general meeting.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio and Telecommunication Section. Informal evening on "Colour Television," talks by L. C. Jesty and Dr. E. L. C. White.

NEWCASTLE-UPON-TYNE. — King's College, 6 p.m. I.E.E. North-Eastern Radio and Measurements Group. Annual general meeting. "The B.B.C. Sound Broadcasting Service on Very-High Frequencies," by E. W. Hayes and H. Page.

County Hotel, Neville Street, 6.30 p.m. North East Electrical Club. "Ships' Cargo Winches and Wharf Crane Control," by R. Clark.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. "Lighting in Crime Detection."

Tuesday, 2nd April

CARDIFF.—Angel Hotel, Westgate Street, 7.30 p.m. A.S.E.E. South Wales Branch. Film show.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33 kV and above," by A. Morris Thomas and D. F. Oakeshott.

HAMMERSMITH. — Windsor Castle Hotel, 134, King Street, 7.30 p.m. A.S.E.E. West London Branch. "Diesel Engines," by J. C. Barber.

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "The Teaching of Electrical Installation Subjects," opened by R. W. G. Ward.

At the I.E.E., Savoy Place, W.C.2, 5 p.m. Institution of Post Office Electrical Engineers. "The Corrosion of Underground Telecommunication Cables," by J. Gerrard and J. R. Walters.

Café Royal, W.1. Illuminating Engineering Society. Annual dinner and dance.

Connaught Rooms, 11.45 a.m. Electrical Industries Club. Annual general meeting, to be followed by monthly luncheon, at 12.30 for 1 p.m.

At the Royal Institution, Albemarle Street, W.1, 5.30 p.m. Institution of Chemical Engineers. Meeting held in conjunction with British Nuclear Energy Conference. "The Aqueous Homogenous Reactor," by R. Hurst.

1, Birdcage Walk, S.W.1, 6.45 p.m. Institution of Mechanical Engineers, Education Group Discussion. "The Need for Technologists in the Next Ten Years and how it is likely to be met."

At the Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2, 7 p.m. Incorporated Plant Engineers, London Branch. "Applications of Plastics in Industry," by Dr. C. L. Child.

LOUGHBOROUGH. — Loughborough College, 6.30 p.m. I.E.E. East Midland Centre. "Power Amplifiers used in Automatic Control," by J. V. Parry.

LUTON.—Chamber of Commerce, George Street West, 8 p.m. A.S.E.E. Luton Branch. "Physical Aspects of Electricity," by S. J. Emerson.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. "Earth Electrode Systems for Large Electric Stations," by J. D. Humphries.

NEWCASTLE-UPON-TYNE.—City Hall, 7 p.m. I.E.E. North-Eastern Centre. Faraday Lecture on "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

Crown Hotel, 7.30 p.m. A.S.E.E. Tyneside Branch. "Earthing and Earth Leakage Protection," by J. A. Robbins.

READING.—Palmer Hall, West Street, 7.15 p.m. A.S.E.E. Oxford, Reading and District Branch. "Lighting Specification, Design and Planning," by W. Imrie-Smith.

YORK.—Royal Station Hotel, 7 p.m. I.E.E. North Midland Centre. "The Potentialities of Railway Electrification at the Standard Frequency," by E. L. E. Wheatcroft and H. H. C. Barton.

Wednesday, 3rd April

ALDERSHOT.—"Beehive Inn," High Street, 7.30 p.m. A.S.E.E. Aldershot and District Branch. "Space Heating with particular reference to Floor-Warming," by G. R. Lomax.

BOURNEMOUTH.—Grand Hotel, 7.30 p.m. Incorporated Plant Engineers, Southern Branch. "Industrial Diseases," by Dr. K. Biden-Steele.

DUNDEE.—New Imperial Hotel, 15, Tally Street, 7.30 p.m. Institution of Production Engineers, Scotland Region. "Automatic Control of Machine Tools," by A. G. Barton.

EDINBURGH.—Y.M.C.A., 14, South St. Andrew Street, 6.15 p.m. I.E.S. Edinburgh Centre. Annual general meeting and social evening.

GLASGOW.—At the Institution of Engineers and Shipbuilders in Scotland, Elmbank Crescent, 8 p.m. A.S.E.E. Glasgow Branch. "Manufacture of H.V. and L.V. Cables and their Uses."

HARRINGAY.—"Queens Head," 677, Green Lanes, 7.45 p.m. A.S.E.E. North London Branch. "Safe Use of Electricity."

LEICESTER.—Grand Hotel, 6.45 p.m. Institution of Heating and Ventilating Engineers, East Midlands Branch. Annual general meeting. John Hughes Prize night. Social evening and installation of the new chairman, Mr. A. J. Whichcord.

LONDON.—Savoy Place, W.C.2, 6.30 p.m. I.E.E. London Graduate and Student Section. "Electric Breakdown in Gases," by A. E. D. Heylen.

Connaught Rooms, Great Queen Street, W.C.2. Electrical Association for Women. Annual conference and luncheon.

MANCHESTER. — Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. "Television as an Aid to Industry."

MIDDLESBROUGH.—Cleveland Scientific and Technical Institute, Corporation Road, 6.30 p.m. I.E.E. Tees-side Sub-Centre. Annual general meeting. "The Measurement of Earth-Loop Resistance," by Dr. G. F. Tagg.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.S. Newcastle-upon-Tyne Centre. Annual general meeting.

PORTSMOUTH. — College of Technology Extension, Anglesea Road, 6.30 p.m. I.E.E. Southern Centre. Annual general meeting. "The Human Operator in Closed Loop Control Systems," by Professor C. Holt Smith.

PRESTON. — R.A.F.A. Club, East View, 7.30 p.m. A.S.E.E. Preston Branch. "Supervisory Remote Control and Telemetering Systems," by D. A. Brett.

Thursday, 4th April

CHELTENHAM.—Technical College, 7 p.m. I.E.E. Bristol Graduate and Student Section. "Printed Circuits," by W. M. Sweetenham.

CROYDON.—Half Moon Hotel, Broad Green, 8 p.m. A.S.E.E. South London Branch. "Relay Control."

GLASGOW.—At the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Telemetry," by A. Cowie.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Kelvin Lecture on "Infra-Red Radiation," by Dr. G. B. B. M. Sutherland.

17, Belgrave Square, S.W.1, 6 p.m. Institute of Metals, London Local Section. Annual general meeting. "Recent Developments in Electron Microscopy," by Dr. J. Nutting.

MANCHESTER. — College of Technology, Sackville Street, 6.30 p.m. British Institution of Radio Engineers, North Western Section. "Electronic Control of Machine Tools," by H. Ogden.

NOTTINGHAM.—Electricity Service Centre, Smithy Row, 5.30 p.m. I.E.S. Nottingham Centre. "The Architect and the I.E.S. Code," by A. Buchanan Campbell.

STOKE-ON-TRENT.—North Stafford Hotel. E.I.B.A. North Staffordshire Branch. Buffet-dance.

TORQUAY.—Electric Hall, 3 p.m. I.E.E. South-Western Sub-Centre. "Television Interference," by P. W. Crouch.

Friday, 5th April

CHELTENHAM. — North Gloucestershire Technical College, 7 p.m. British Institution of Radio Engineers, South Midlands Section. "Colour Television," by Dr. G. N. Patchett.

Rotunda, 7.30 p.m. Society of Instrument Technology, Cheltenham Section. Annual general meeting. Presidential address, by A. J. Young.

FAWLEY. — Copthorne House, 7 p.m. Society of Instrument Technology, Fawley Section. Annual general meeting.

HARROGATE.—Cairn Hydro Hotel, 7.15 for 8 p.m. I.E.E. North Midland Centre. Annual dinner-dance.

LIVERPOOL.—At the Liverpool Engineering Society, 9, The Temple, 24, Dale Street, 7.30 p.m. A.S.E.E. Liverpool Branch. "Servicing the Automobile Electrical Equipment."

LONDON.—Hope House, 45, Great Peter Street, S.W.1, 7 p.m. Women's Engineering Society. "The Use of Electronic Computers in Engineering," by Miss Jill Robinson.

Connaught Rooms, W.C.1, 6 for 6.30 p.m. Association of Supervising Electrical Engineers. Annual dinner.

NEWCASTLE-UPON-TYNE. — King's College, 6.30 p.m. I.E.E. North-Eastern Graduate and Student Section. Annual general meeting.

County Hotel, 6.30 p.m. Institution of Heating and Ventilating Engineers, North East Coast Branch. Smoking concert.

Saturday, 6th April

LONDON.—I.E.E. London Graduate and Student Section. Visit to Chadwell Heath substation at 10.30 a.m.

1958 Electrical Engineers Exhibition

The 1958 Electrical Engineers Exhibition will again be held at Earls Court, from 25th to 29th March. A large number of inquiries for stand space in 1958 have already been received. All stand space for the 1957 exhibition, which will be opened by Lord Hailsham, Minister of Education, on 9th April, has been taken up; nearly 400 exhibitors will be showing.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—Electricity Commission of New South Wales, Sydney. 15th April. Distribution boards and two outdoor 100 kVA transformers with switchboards. (E.S.B. 7322/57. Ten/24862.)* 29th April. Six 15 MVA, 33/11 kV transformers. (E.S.B. 6644/57. Ten/24776.)* 29th April. Five 30 MVA, 132 kV power transformers. (E.S.B. 7190/57. Ten/24873.)*

Electricity Commission of Queensland, Brisbane. 17th April. Eight 11 kV, 75 MVA circuit-breakers. (E.S.B. 7335/57. Ten/24861.)*

Belgium.—Belgian Telegraphs and Telephones, Brussels. 3rd April. Insulated cables and wires. (E.S.B. 7287/57. Ten/24879.)*

Formosa.—Central Trust of China, Taipei. 23rd April. Electrical equipment including power and control panels, selenium rectifiers and lead storage batteries. (E.S.B. 7491/57. Ten/24876.)*

Greece. — State Procurements Service, Ministry of Finance. 13th April. Rubber insulated cables. (E.S.B. 7294/57. Ten/24887.)*

India. — Stores Purchase Committee, Government of Mysore, Bangalore. 4th April. L.v. switchgear. (E.S.B. 6980/57. Ten/24802.)*

Madhya Pradesh Electricity Board, Nagpur. 24th April. Electricity meters. (E.S.B. 6594/57. Ten/24759.)*

Orissa Electricity Department, Puri. 3rd June. 132 kV single circuit transmission line. 4th June. Additional equipment for Rayagada substation and switchgear, transformers and other equipment for Berhampore 132 kV substation. (E.S.B. 6988/57. Ten/24814.)*

Damodar Valley Corporation, Calcutta. 25th April. Feed water heaters for 75 MW units. (E.S.B. 7016/57. Ten/24837.)*

Chief Engineer (Electricity), Trivandrum. 12th April. Insulators and accessories. (E.S.B. 7165/57. Ten/24854.)* 24th April. Lightning arrestors. (E.S.B. 7166/57. Ten/24866.)*

Iraq.—Director General of Municipalities, Baghdad. 11th May. 100 kW d.c. diesel generating set. (E.S.B. 7116/57. Ten/24871.)* Two 100 kW and one 50 kW a.c. generating sets. (E.S.B. 7115/57. Ten/24870.)*

Development Board, Ministry of Development. 11th June. Three 15,000 kW steam driven turbo-generators. (E.S.B. 7118/57. Ten/24869.)*

Nairn.—Burgh Council. 27th April. Street lighting installation. (See this issue.)

New Zealand.—N.Z. Post Office. 17th April. Protectors, fuses and arrestors. (E.S.B. 7173/57. Ten/24853.)* 26th April. Paper jointing sleeves. (E.S.B. 6878/57. Ten/24830.)* 29th April. Switches. (E.S.B. 7090/57. Ten/24860.)* 30th April. Stay clamps. (E.S.B. 6879/57. Ten/24790.)* 1st May. Cable and insulated wire. (E.S.B. 7172/57. Ten/24865.)* 3rd May. Voltmeters, ammeters and wattmeters. (E.S.B. 6877/57. Ten/24830.)*

Portuguese East Africa.—Ports, Railways and Transport Department, Lourenço Marques. 20th May. L.v. switchboard. (E.S.B. 6560/57. Ten/24785.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Rhodesia and Nyasaland.—Federal Tender Board, Causeway. 5th April. Electrically driven pumping plant. (E.S.B. 7500/57. Ten/24886.)*

Saddleworth.—U.D.C. 13th April. Street lighting equipment. (See this issue.)

South Africa.—Durban Electricity Department. 12th April. 11,000 V and 660 V underground cables. (E.S.B. 6378/57. Ten/24762.)*

Union Tender and Supplies Board, Pretoria. 11th April. X-ray apparatus. (E.S.B. 7021/57. Ten/24847.)*

Turkey.—H.Q. Command, Office of the Purchasing and Contract Officer, Allied Land Forces, South Eastern Europe, Izmir. 8th April. Insulated cable. (E.S.B. 7133/57. Ten/24827.)*

United States.—Clark County Public Utility District No. 1, Vancouver, Washington. 11th April. 7,500 kVA transformer with fans and two 15 kV oil circuit-breakers. (E.S.B. 6906/57. Ten/24810.)*

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Bath.—New science wing at Kingswood School; W. Forsyth & Partners, architects, 47, Nottingham Place, London, W.1.

Bedfont.—Flats (30), Green Man Lane; Winckley Estates, Ltd., 167, Church Road, Northolt.

Bedford.—Factory, Kempston; Texas Instruments, Ltd., 18, Austin Friars, London, E.C.2.

Blaydon-on-Tyne. — Cleansing depot (£11,500); T. Mills, U.D.C. surveyor.

Bournemouth.—Bungalows (228), Anstey Road and Ringwood Road; Lansbourne, Ltd., Office Chambers, Lansdowne House.

Brighton.—Three-storey garage, etc.; Fletcher & Co., 24, Bedford Place, Hove, 2.

Bromsgrove.—Science block for boys' public school; Holland W. Hobbiss, architect, 36, Waterloo Street, Birmingham.

Canterbury.—Physics block and conversions at King's School, for Governors; Braddell and Laurence, architects, 6, Bedford Row, London, W.C.1.

Chailey.—Nurses' home at Heritage Hospital (£26,200); secretary, South East Metropolitan Regional Hospital Board, 11, Portland Place, London, W.1.

Chester.—First instalment of secondary modern school, Hoole (£120,535); C. Greenwood, city surveyor, 43, Northgate Street.

Coalville.—Houses (66), Greenhill estate; Council's architect.

Cumberland. — Home, Skinburness (£11,500); J. H. Haughan, county architect, Portland Square, Carlisle.

Darlington.—Staff accommodation block, stores block, etc., for proposed diesel depot for British Railways (£44,000); Blackett & Son, builders, Bondgate, Darlington.

Dewsbury.—Dwellings (168), Ouselwell Lane; borough engineer.

Office block; Wm. Crabtree & Sons, Ltd., Westfield Mills, Heckmondwike Road.

Doncaster.—New Curlew (Clay Lane) Primary School (£39,016); borough architect.

Durham.—Housecraft block at Washington Grammar Technical School (£21,000); Graham & Mansworth, builders, Forest Hall, Newcastle-on-Tyne.

Fire stations at Newton Aycliffe, Norton and Dunston; G. R. Clayton, architect, South Street, Durham.

Eastbourne. — Junior school, Victoria Drive; Howard V. Lobb & Partners, architects, 20, Gower Street, London, W.C.1.

Gateshead.—Factory, Team Valley, for the Armstrong Cork Co., Ltd.; Cordingley & McIntyre, architects, Owengate, Durham.

Gloucester.—Houses (67), Frampton-on-Severn; Dancey and Meredith, architects to R.D.C., Bleak House, Station Road, Gloucester.

Great Yarmouth.—Departmental stores on Plaza Cinema site, Market Place; E. Woodbourne, staff architect, F. W. Woolworth & Co., Ltd., 1, New Bond Street, London, W.1.

Halifax.—Dwellings for old persons (100); G. Holden, borough surveyor, Crossley Street.

High Wycombe.—Houses (134), Castlefield, New Road and Totteridge Drive; J. A. Parkinson, borough surveyor, Municipal Offices.

Leicester.—Chemistry buildings for University College; Architects' Co-partnership, 44, Charlotte Street, London, W.1.

London.—Extension (£1,000,000) for Selfridge & Co., Ltd., Oxford Street; Gee, Walker & Slater, Ltd., builders, 100, Park Lane, W.1.

Office block, Gray's Inn Road; Trehearne & Norman, Preston & Partners, architects, 83, Kingsway, W.C.2.

Macclesfield.—Extensions to factories and research department; Ernest Scragg & Sons, Ltd., Sunderland Street Works.

Malden and Coombe.—Flats and maisonnettes (99), on sites at Kingston Road, Kingston Vale, Newhouse Close, Potters Grove and Rodney Road; J. Apse, borough engineer, Municipal Offices, New Malden, Surrey.

Margate.—Maternity unit at the General Hospital; Adams, Holden & Pearson, architects, 38, Gordon Square, London, W.C.1.

Northampton.—Conversion of houses, St. George's Avenue, into home for old people (£20,000); borough architect.

Norwich.—Hostel for disabled persons in Vauxhall Street (£39,000); D. Percival, city architect.

Reading.—Factory extension; Gascoigne Crowther, Ltd., Ardler Road, Caversham.

Reigate.—Dwellings (43), Rushetts Farm estate; borough surveyor.

Ryton (Co. Durham).—Maternity and child welfare clinic (£15,000); county architect, South Street, Durham.

St. Albans. — Warehouse and offices (£25,000); I. Beer & Sons, Ltd., provision merchants and importers, 10, Hosier Lane, London, E.C.1.

Sunderland.—Anglican church, Hylton Red House estate (£15,000); Cordingley & McIntyre, architects, Owengate, Durham.

Offices, drawing offices and canteen for North-East Metal Fabrications, Ltd.; Matkin & Hawkins, architects, Barclays Bank Chambers, Fawcett Street, Sunderland.

First stage of £250,000 abattoir scheme; borough architect.

Houses (132) on the Hylton Red House estate; borough architect, Grange House, Stockton Road, Sunderland.

Surbiton.—Flats (32), Maple Road and Berrylands Road; Clifford Culpin, architect, 39, Doughty Street, London, W.C.1.

Swansea.—Showrooms and offices, Christina Street; National Cash Register Co., Ltd., 206, Marylebone Road, London, N.W.1.

Wallsend.—Secondary technical school, Boyd Road; Gray & Partner, architects, Camden Street, North Shields.

Walthamstow.—Works extensions; Collinson's Precision Screw Co., Ltd., Forest Road, London, E.17.

Warminster.—County secondary modern school; F. I. Bowden, county architect, County Hall, Trowbridge.